

faceshift studio 2014.1



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[www.faceshift.com](http://www.faceshift.com)

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What is faceshift studio?

Prerequisites

Installation

License Activation

Start faceshift studio



## 1. Introduction

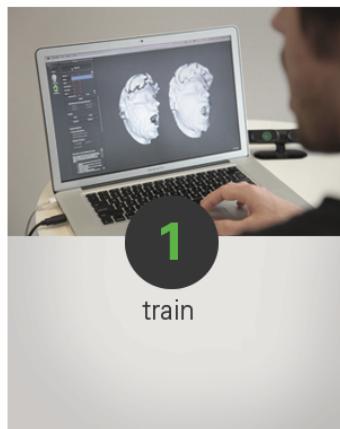
### 1.1 What is faceshift studio?

Faceshift studio is a facial motion capture software solution which revolutionizes facial animation, making it possible at every desk. The software analyzes the facial movements of an actor and describes them as a mixture of basic expressions, plus head orientation, and eye gaze. This description is then used to animate virtual characters for use in any situation where facial animation is required, such as movie and game production.

Faceshift studio's animation pipeline is comprised of three intuitive steps:

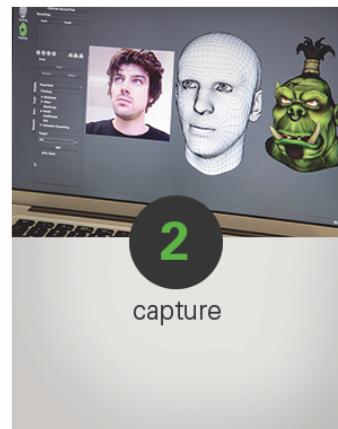
- Scan a set of expressions to train your personalized avatar for tracking.
- Capture a performance with real-time feedback, and optionally improve the accuracy in a post-processing stage.
- Animate virtual avatars in faceshift and export the animation to your favorite 3D animation software, or connect to your existing animation pipeline.

In order to get faceshift studio, please visit our website [or contact us at support@faceshift.com](#).



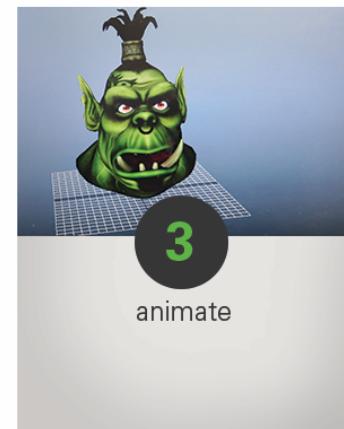
1

train



2

capture



3

animate

## 1.2 Prerequisites

Faceshift studio combines astonishing real-time tracking and high quality offline post-processing in a single, convenient application. There is no need for expensive motion capture setups, all you need is a consumer depth camera (see Supported 3D Sensors 1.1) and a standard computer. If you need a sensor, please contact us at [support@faceshift.com](mailto:support@faceshift.com).

Camera	OS	Quality
PrimeSense Carmine 1.09	Mac OS X Windows (OpenNI) Linux (OpenNI)	Best quality
Asus Xtion Pro Live	Mac OS X Windows (OpenNI) Linux (OpenNI)	Best quality
Microsoft Kinect for Xbox 360	Mac OS X Windows (MS Kinect SDK, OpenNI*) Linux (OpenNI*)	Good quality
Microsoft Kinect for Windows	Windows (MS Kinect SDK) Linux (OpenNI*)	Good quality

Table 1.1: Supported 3D Sensors

\*The Kinect is supported only via the unofficial drivers at <https://github.com/avin2/SensorKinectx>.

## Driver Downloads

OSX drivers come pre-installed. For Windows, choose your sensor below, download, and install drivers.

- Primesense Carmine OpenNI 2 drivers
- Asus Xtion Live pro OpenNI 2 drivers
- Kinect for Windows
- Xbox 360 Kinect

## 1.3 Installation

### 1.3.1 Windows

- Install the drivers for your 3D sensor (see Supported 3D Sensors 1.1)
- Download faceshift studio (you will find the link either on the invoice you received after a purchase, or in the email you received after requesting a trial)
- Install the software
- Start faceshift studio
- Enter the activation code you received when you purchased faceshift studio (read more in section 1.4)

### 1.3.2 Mac

- Download faceshift studio (you will find the link either on the invoice you received after a purchase, or in the email you received after requesting a trial)
- Install the software (no need to install any driver)
- Start faceshift studio

- Enter the activation code you received when you purchased faceshift studio (read more in section 1.4)

## 1.4 License Activation

Your faceshift studio license needs to be activated via our Internet activation server. Enter or paste the activation code you received when you purchased faceshift studio. If you have entered a valid activation code, hitting the Activate button will generate a message window acknowledging the successful activation of the software.

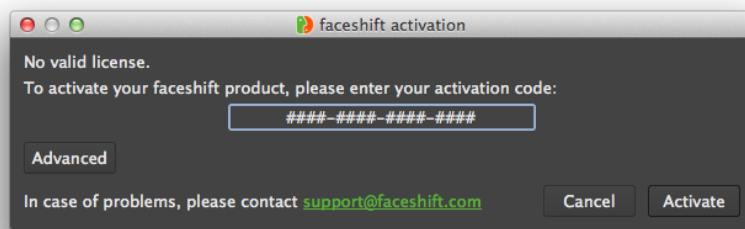


Figure 1.1: License activation dialog

### Advanced Options

Hitting the Advanced button, more options appear (see figure 1.2), allowing you to activate faceshift studio also in the following cases:

- **Your computer is not connected to the internet:** Check the **Offline Activation** checkbox and send the generated file (located in the faceshift studio workspace directory) to [support@faceshift.com](mailto:support@faceshift.com).
- **Your computer is behind a proxy server:** Enter the proxy address and optionally the credentials

### Rehosting your License

In the Preferences, you will find a "License" tab with some additional information about your license like the remaining days before expiration. You also have the possibility to rehost your license if you want to use faceshift on another computer. If your computer is not connected to the internet, check the **Offline** checkbox and send the generated file (located in the faceshift studio workspace directory) to [support@faceshift.com](mailto:support@faceshift.com).

Please note that the rehosting only works for a limited number of activations (5 by default).



This feature is not available in the Trial version of faceshift studio.

### Troubleshooting

In case activation fails, faceshift studio will display an error message with the failure reason.

- **Error -134:** This error might occur when Avast antivirus is running. Please disable Avast for the duration of the activation and enable it again afterwards.

For any other errors, please contact us at [support@faceshift.com](mailto:support@faceshift.com).

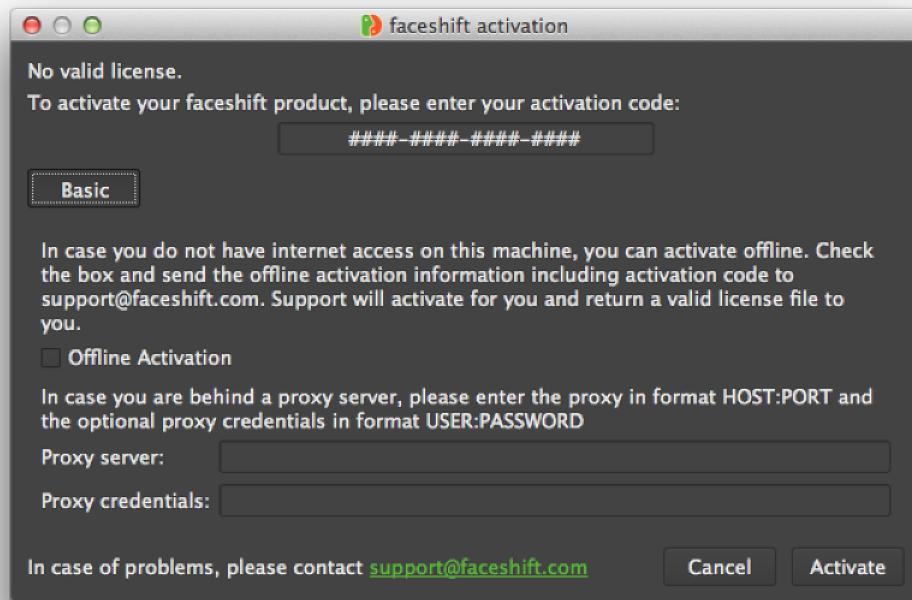


Figure 1.2: License activation advanced options

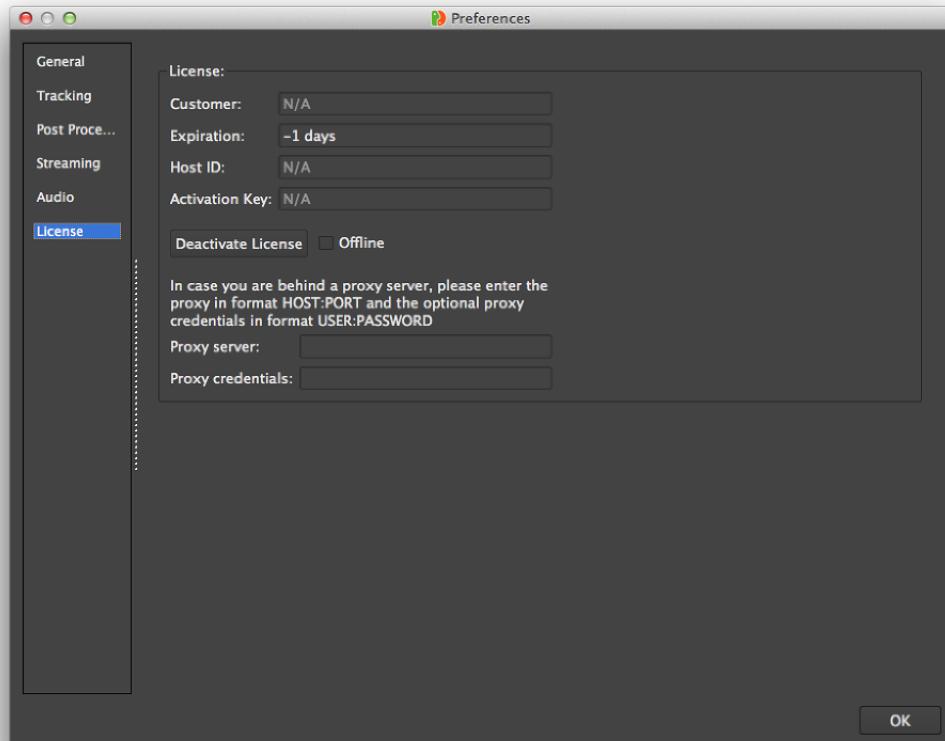


Figure 1.3: License Rehosting Dialog

## 1.5 Start faceshift studio

The first time you run faceshift studio, you have to choose the location of the faceshift studio workspace data. Workspace data includes actor profiles and recorded clips, but also the faceshift studio license and log data. The default path is \$Home/Documents/faceshift. Click "Browse" to change the location of the folder. If you want to change the location later, go to Preferences and change the workspace in the "General" tab (see section 5.2).

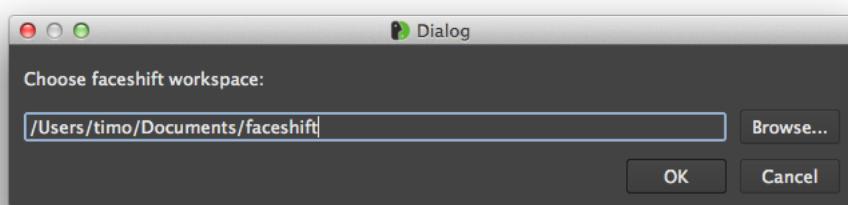


Figure 1.4: Choosing your workspace

Faceshift studio is now correctly installed on your system and your 3D sensor is correctly plugged-in. You can now start using faceshift studio after selecting the right driver for your sensor.



Figure 1.5: Starting faceshift studio

Faceshift studio is divided into three different modes: **Setup** (Chapter 2), **Training** (Chapter 3), and **Tracking** (Chapter 4). The modes can be activated via the menu or the buttons at the left of the screen (see figure 1.6).

Setup is used to check that the camera works and the data is good. Training is needed once for each new user to build his/her personalised template. Tracking is what faceshift studio is for.

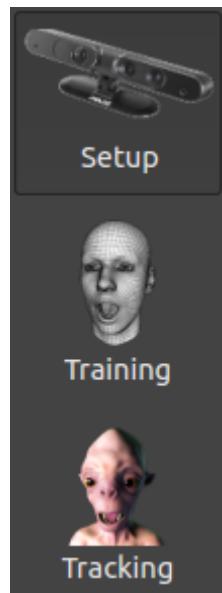


Figure 1.6: The 3 different modes

Check out this first tutorial for a general overview of the faceshift application and features:  
[Tutorial - faceshift studio Overview](#)



## 2. Setup

For accurate facial tracking, it is very important to set up the camera carefully, because the accuracy of the reconstructed profile and recordings depends on the quality of the input. We recommend to always first check the 3D data in the setup view. Click the camera symbol with the title Setup.

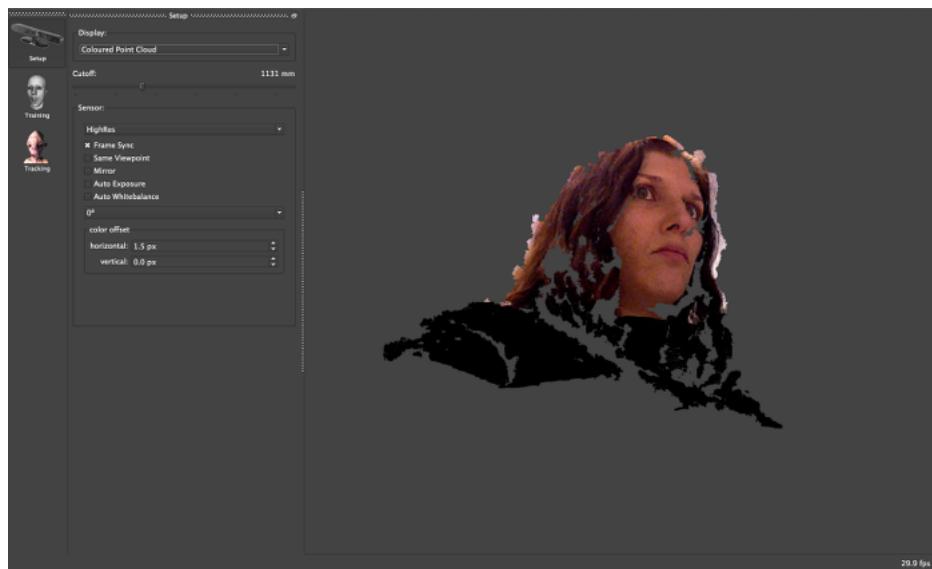


Figure 2.1: The Setup mode

On the right side you can see the rendered image. You can zoom in and out using the mouse wheel. If it shows 3D data (as in the figure 2.1 where we show the colored point cloud) then you can also rotate it by pressing the right mouse button and dragging.

In the middle column are the different options of the setup mode. We describe each of them in the following sections.

Please refer to section 7.1 to learn how to get optimal data from the sensor or watch the corresponding tutorial video:

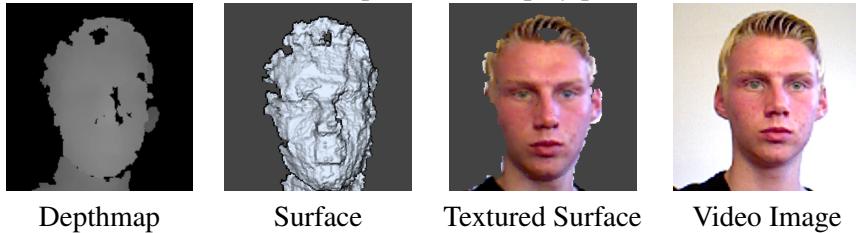
[Tutorial - Setup View](#)

## 2.1 Display

The following data can be displayed:

- **None:** This will not show any data
- **Depthmap:** A grayscale image of the depth
- **Surface:** The scene as a shaded 3D object
- **Textured Surface:** The scene as a colored and shaded 3D object
- **Point Cloud:** Each datapoint from the sensor rendered independently
- **Colored Point Cloud:** Each datapoint from the sensor rendered independently and colored with the video
- **Video:** The color stream from the sensor
- **Surface in Video:** The 3D surface overlayed on top of the color stream

Table 2.1: Here are some examples of the display possibilities listed above:



## 2.2 Cutoff

The cutoff function allows you to restrict the 3D data to a certain depth range. Everything farther away from the sensor than the given cutoff distance will be discarded. Note that the cutoff will not change the tracking quality, but it may slightly increase performance when discarding geometry in the back, i.e., walls and objects behind you. If set to 0, the cutoff will be completely disabled.

## 2.3 Sensor

### Frame Sync (Only for OpenNI 1 and 2)

If checked, then the frames of depth and video are always synchronized, i.e., set to the same time code. We recommend to have this checked. Note: There are rare situations where the data input freezes due to the sensor driver. In this case, briefly uncheck Frame Sync and then check it again.

The following options are only available for OpenNI 2:

### Mirror

This flips both the color image and the depth map left-right.

### Auto Exposure

Automatically adjusts the exposure to the lighting. We recommend to do this once whenever your lighting conditions change and then uncheck it for the processing. This makes sure you do not have unwanted brightness changes during the tracking.

### Auto Whitebalance

Automatically adjusts the white balance. We recommend to do this once whenever your lighting conditions change and then uncheck it for the processing. This makes sure you do not have unwanted color changes during the tracking.

### **Sensor Orientation**

Allows rotating the image and the depth map. Use this if you set up your sensor vertically or upside down.

### **Color Offset**

Here you can adjust a shift between the color image and the depth image. Use this if depth data and color data are not aligned correctly. You can see if they are aligned on horizontal and vertical sharp edges, see section [7.1.3](#).



Capturing a profile

Options

The Set of Training Expressions

Tracked Blendshapes

Edit the Template Rig

Marker Set Editing



### 3. Training

Each person using faceshift studio requires a custom profile. This profile represents a user specific expression model, i.e., a set of blendshapes that represent the different expressions a user can do (we use the term blendshape to represent a certain facial expression - the equivalent of morph targets). For example, it contains a blendshape Jaw Open which represents the way a specific person opens their mouth. Currently, we are tracking a fixed set of blendshapes, which can then be mapped to the target rig. As of faceshift studio 2014.1, the default blendshape rig contains 51 blendshapes. Section 3.5 describes how you can change which blendshapes are tracked. If you would like to use the previous blendshape sets from previous versions of faceshift studio, please send a mail to [support@faceshift.com](mailto:support@faceshift.com).

In the training mode, the actor creates their profile by recording a set of predefined expressions and faceshift studio will automatically calculate all blendshapes for the user.

[Tutorial - Training Overview](#)

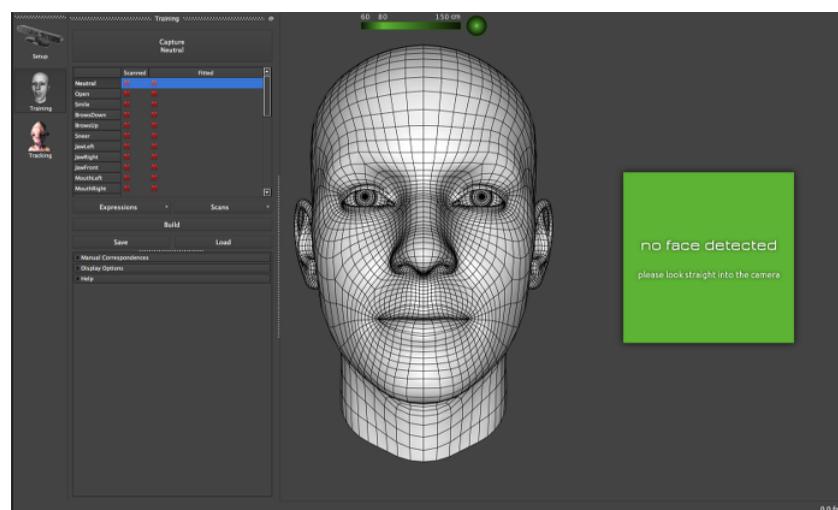


Figure 3.1: The Training module

### 3.1 Capturing a profile

In order to capture a set of training expressions, you need to do the following:

- Select the expression to capture in the expression table on the left.
- As a guide, we visualize the expression on the default head.
- Look into the sensor, perform the required expression and keep it fixed; faceshift studio will detect your face and display it as a video image and depth scan (see figure 3.2). In case the face is not detected, a message will appear (see figure 3.4).
- Press and hold the **Capture** button, then turn the head slightly left and right **without changing the expression** so that faceshift studio can combine the data from the sensor to build one noise-free scan of your face (see figure 3.3).
- When finished, look into the camera again, release the Capture button and move on to the next expression.

Once the expressions have been captured, press **Build** and faceshift studio will build your actor profile. Save it using the **Save** button so that you may start a new session at any time without having to go through the training phase again. To load a trained expression model, click **Load**. Since faceshift studio 1.2, the profile file (\*.fsu) also contains the scan data of all captured expressions.

Before using the profile, it is advisable to check that all expressions have been registered well. If an expression is not correctly fit, you can either redo the expression by pressing **Rescan** or add manual markers (see section 3.6).

If you are having trouble in performing particular expressions or getting a good scan for them, you are free to leave them unscanned. In that case, faceshift studio will create the blendshapes for you by applying a generic model to your neutral expression. However, the tracking results will be better using properly scanned expressions.

 When you are confident enough with this phase, you can speed up the training process by enabling "Automatically advance to next expression after scanning" in the "General" section of the Preferences menu.

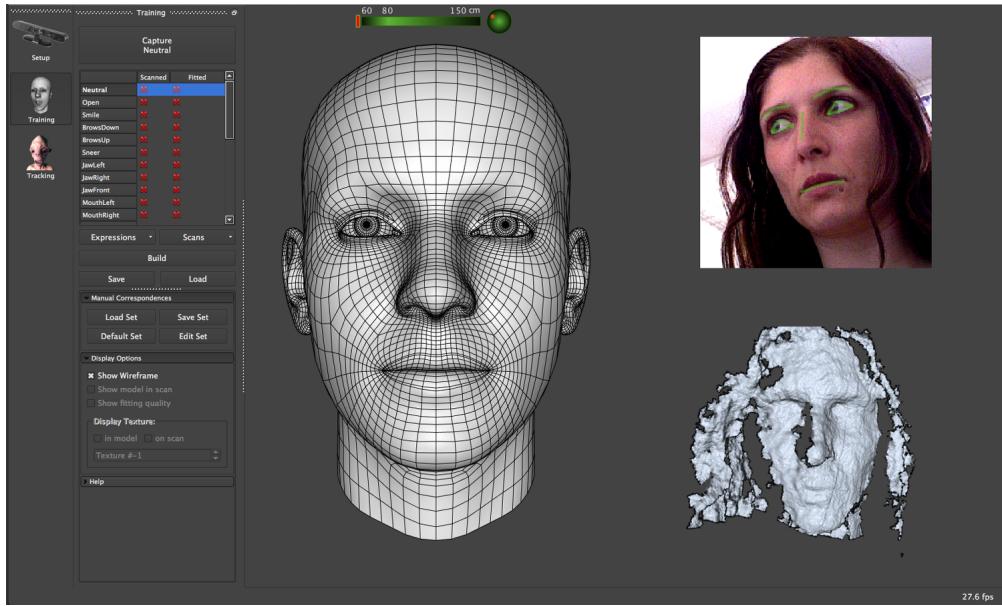


Figure 3.2: The training pane, with the user ready to scan the neutral expression

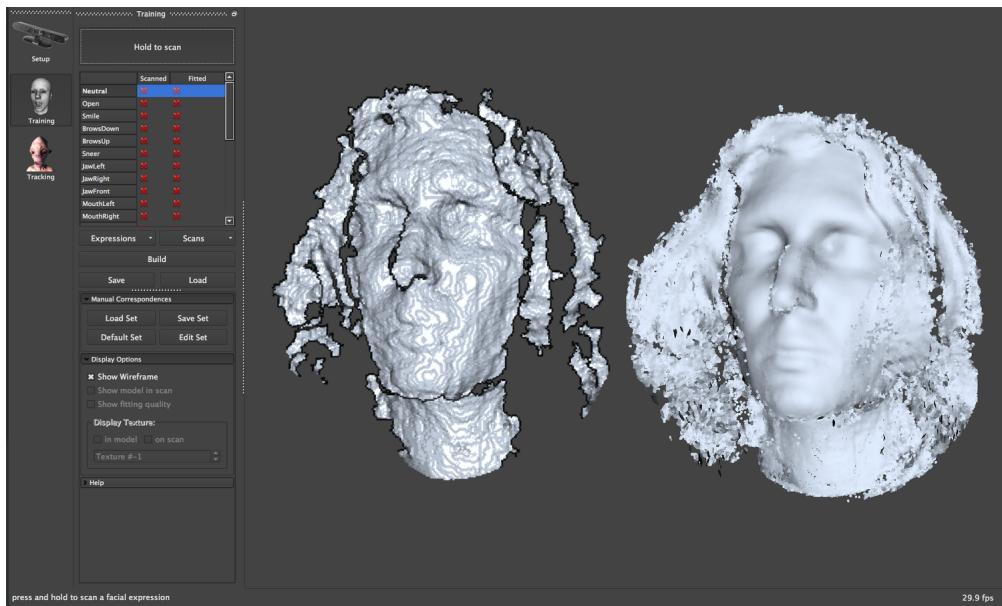


Figure 3.3: Scanning of the neutral expression

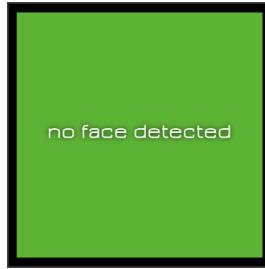


Figure 3.4: Message shown when the face is not detected. Open the setup tab to check that the camera is set up properly, and the video stream and depth data are coming in at a good quality. Also, make sure to properly face the sensor.

## 3.2 Options

### 3.2.1 Manual Correspondences

You can help faceshift studio to compute a better fitting by setting manual correspondences between the model and the captured scan data. Using the buttons here you can change, load, and store the marker sets used for these correspondences. To edit the set of markers, click **Edit Set**; a dialog window pops up where you can add markers. Select markers on the model by clicking, and click again on the corresponding position on the scan to set a correspondence. For further details, see section 3.6.

### 3.2.2 Display Options

- Show Wireframe: Displays the wireframe of the model to give you a better impression of the 3D shape.
- Show model in scan: Overlays the model over the 3D scan data. This visualizes the alignment.
- Show fitting quality: Overlays a heat map on the model to visualize where the model aligns well (blue) and where the distance between the model and the 3D point cloud is larger (red).
- Display Texture: Shows the color textures of the different scanned images projected onto the model and/or the scan.



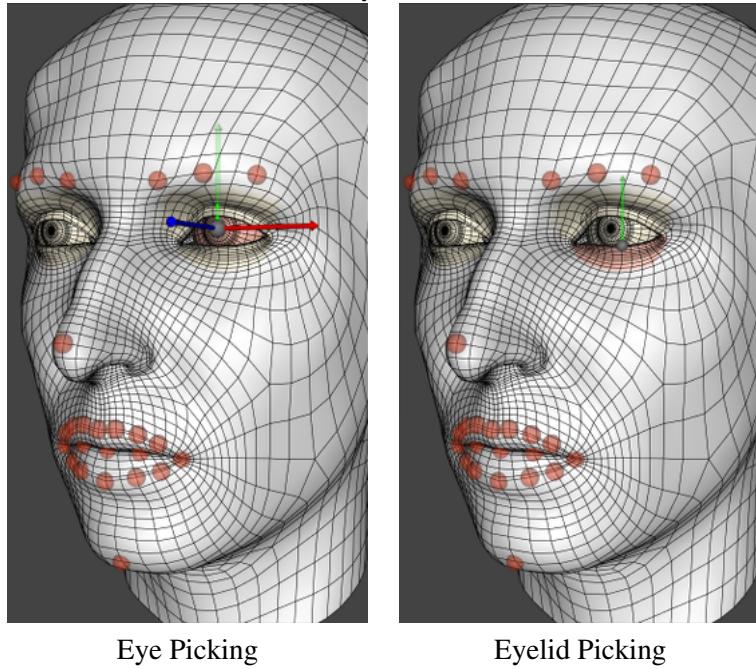
When "Show Wireframe" and "Display Texture" are activated and the model has the focus, press the key "A" to toggle the visibility of the wireframe. It can be useful when trying to modify the eye and/or eyelid positions.

### 3.2.3 Eyes

The eye positions are detected during the fitting of the Neutral expression. At this point you are able to adjust the eye positions and their size if the detection was not accurate enough. When hovering the mouse over the eye regions, the different pickable parts will be highlighted. Clicking on the eyeballs or the eyelid parts will activate a coordinate system widget which allows you to change the position of the eyes or eyelids. Pick an arrow and drag it until the expected position is reached.

At this point, the other expressions need to be fitted again to use these new values. You can simply press **Build** to update your profile.

Table 3.1: Eye Modifications



Since faceshift studio 2014.1, the default expression set includes the new eye expressions (**EyeOpen**, **EyeUp**, **EyeDown**, **EyeBlink** and **EyeSquint**) where you also have the possibility to adjust the eyelid positions if the fitting is not accurate enough.

**R** Please note that if you fit the neutral expression again, the eye positions will be reset to their original positions. This will happen automatically if you move any of the markers on the neutral expression and then build the profile.

This tutorial shows you how to modify the position and size of the eyes:

[Tutorial - Eyes](#)

### 3.3 The Set of Training Expressions

Faceshift studio asks the user to perform the following expressions for training. It is also possible to train with fewer expressions, but this results in a decrease of the tracking quality. More expressions can be added to further improve the tracking by using the Expressions menu below the list of expressions (see Table 3.2).

When scanning the expressions, observe the preview that tells you how it is supposed to look. For instance, Sneer is meant to be performed without showing the teeth. You may choose to train the expression by also pulling up the upper lip. In that case you must adjust the expression by clicking the **Expressions** button, selecting **Edit**, and changing the blendshape activations. For expressions where the mouth is closed, check the **zipper** checkbox, otherwise uncheck it.

Checkout the tutorial video how to add additional expressions for training to improve the tracking model:

[Tutorial - Training Expressions](#)

Checkout the tutorial video on you how you can export the training expressions and blendshapes

models in various formats:  
[Tutorial - Training Export](#)

### 3.4 Tracked Blendshapes

Since faceshift studio 2014.1, 51 blendshapes are used for tracking by default. In the main menu under **Training**, select **Inspect Template Rig** to have a look at all blendshapes used in the default template rig for tracking. Similarly, you can have a look at your own profile by selecting **Inspect Profile**. By clicking on a specific blendshape name you are able to control its value and directly see its effect on the displayed mesh.

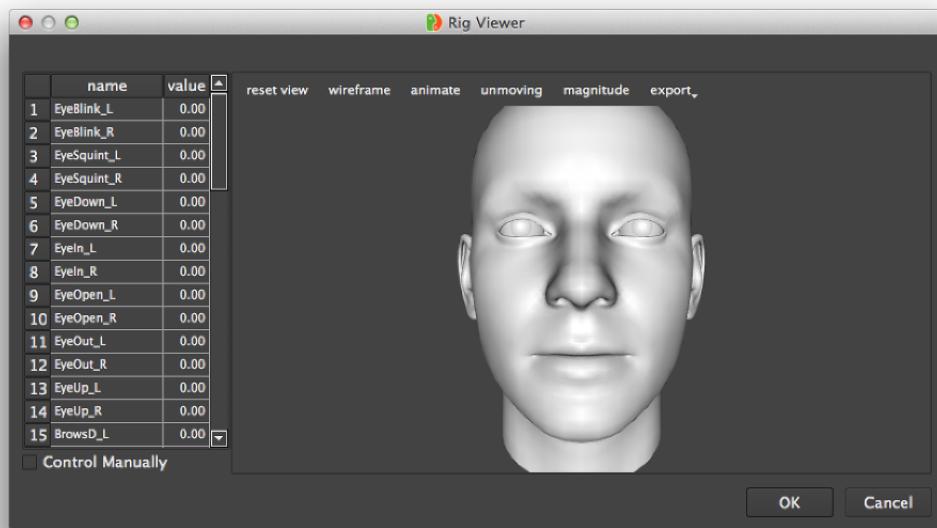


Figure 3.5: Rig viewer dialog

### 3.5 Edit the Template Rig

In the main menu under **Training**, you can select **Edit Template Rig** to add, remove, or modify the blendshapes used by the template. When the **Split** option is selected, the corresponding blendshape is separated into two independent blendshapes, generally for the left and right side.

For example, if the split option is activated for "MouthSmile", "MouthSmile\_L"(left side) and "MouthSmile\_R" (right side) will be considered as two distinct blendshapes. It allows the tracking to be more accurate by handling asymmetric expressions.

Note that you can also disable shapes during tracking, for instance if you know that a certain shape will not be active in a particular take. See section [4.5.4](#).

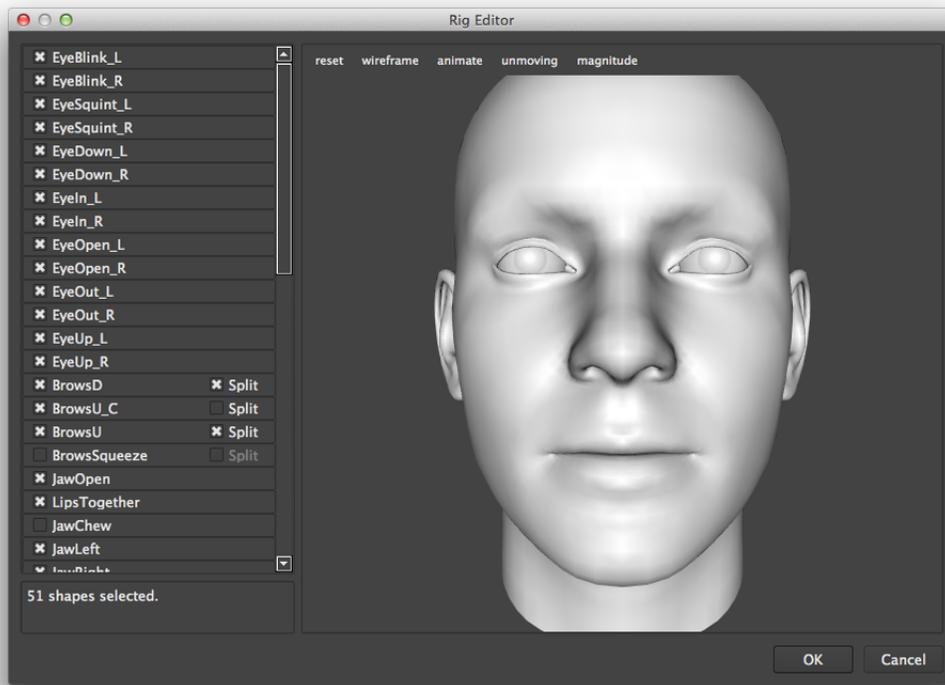


Figure 3.6: Rig editor dialog

### 3.6 Marker Set Editing

Faceshift studio is a marker-less application. However, there are several cases where it is useful to simulate markers as they are used by facial motion capture. In faceshift studio, you will find them in three different contexts:

- In the training mode, you can manually add markers to the scanned faces to help faceshift compute a better fitting.
- Through network streaming, faceshift studio can send virtual markers to other applications as if they were captured by a marker-based motion capture system. The markers that are sent over the network can be configured in the preferences.
- Likewise, virtual markers can be exported in C3D, BVH, or faceshift's open file format.

Whatever the intended use, the marker set can be edited using the same dialog, see figure 3.7.

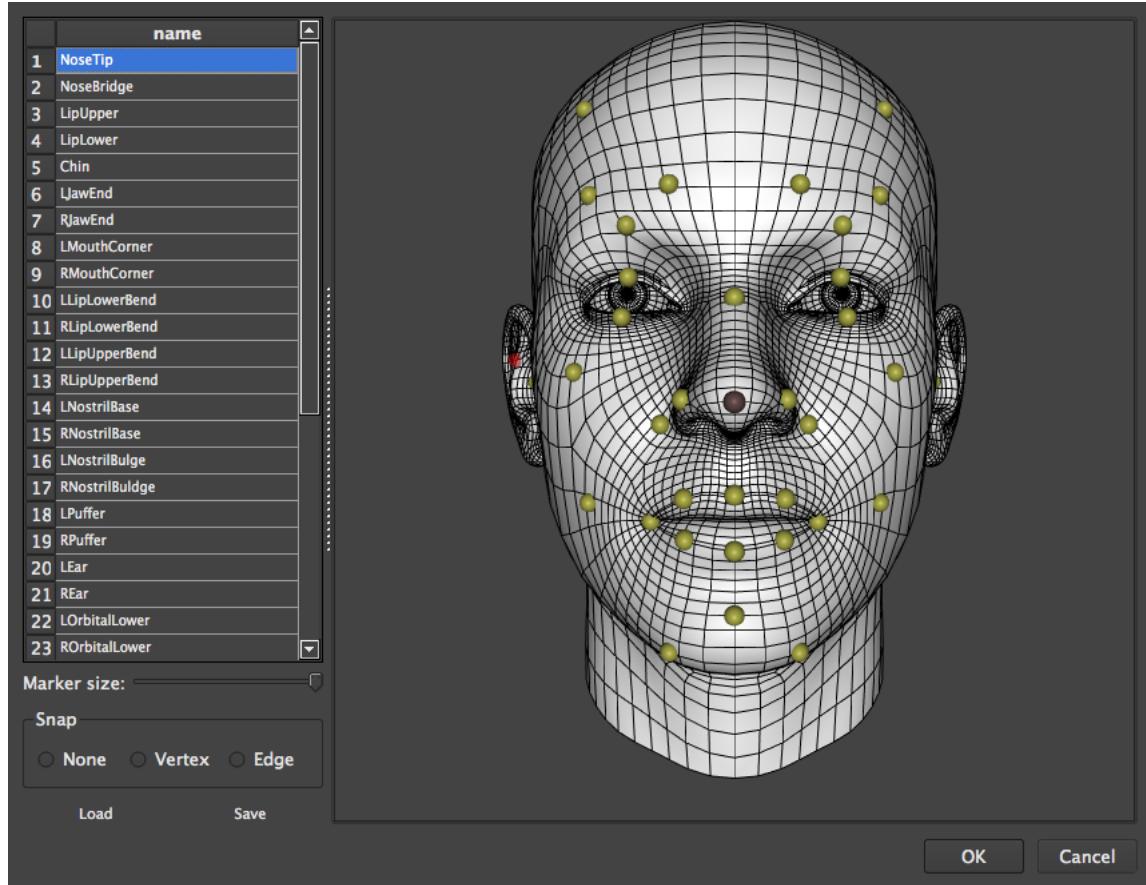


Figure 3.7: Marker editing dialog

In order to add and delete markers (see figure 3.8), right click the mesh and select the corresponding menu entry. If applicable, a symmetric counterpart will be added automatically.

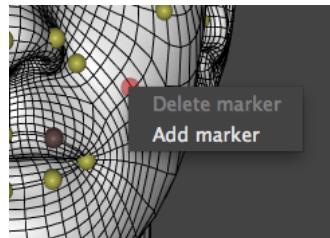


Figure 3.8: Add a marker

The size of the marker spheres can be adjusted using the slider, which can be useful if you want to place markers close to each other. Using the **Snap** radio button, the markers can be forced to lie on a vertex or an edge. You can write the marker set to disk for later reuse using the **Save** button and load it again using the **Load** button.

Editing the markers in the Training module has the same functionalities: adding and removing markers, changing their positions, resizing the markers size using the slider or the mouse wheel while holding the **Control key**.

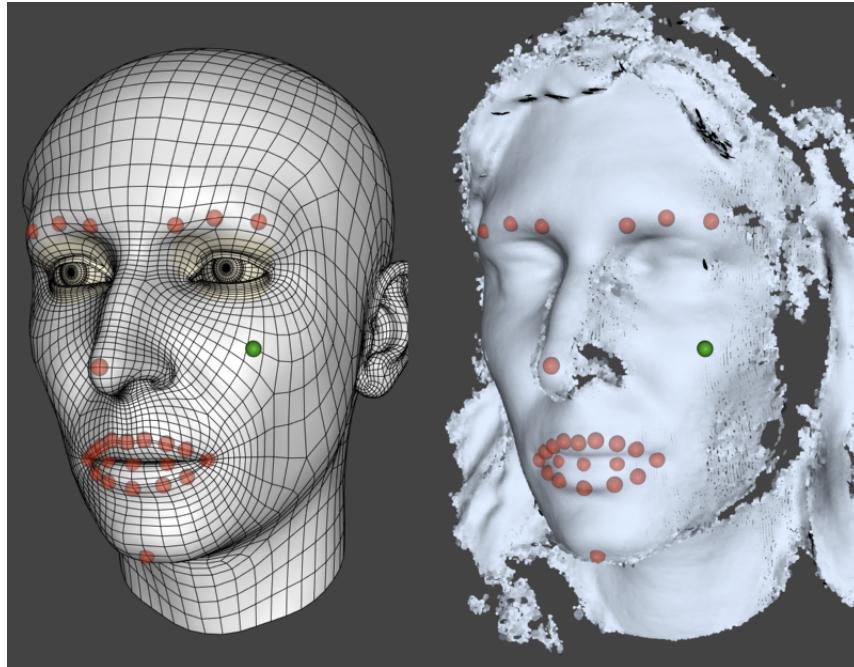


Figure 3.9: Editing markers in the Training Module

When you move a marker, its position will always be projected on the mesh's surface. It can happen that this fitting is wrong and the marker doesn't appear correctly on the surface. In this case, you can use the **Shift** key on the selected marker to see a coordinate system widget appear. You can then change the marker's position in space. But as soon as you move the marker normally it will be projected to the mesh's surface again.

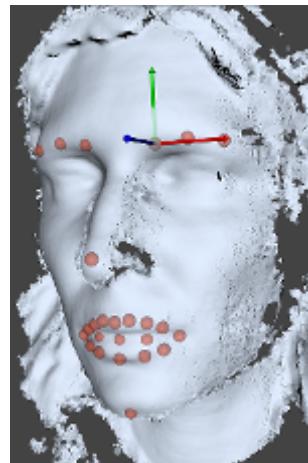


Figure 3.10: Moving markers in space

[Tutorial - Training Markers](#)

Name	Description
Neutral	The actor's neutral expression with closed mouth. For best results the actor should not fully clench the teeth but leave some space between the teeth instead. Note though that the lips should be closed.
Open	The mouth should be opened widely without stretching the mouth corners.
Smile	A wide smile with closed lips.
BrowsDown	As for an angry expression the brows should be put down as much as possible, while keeping the remainder of the face unchanged.
BrowsUp	As for a surprised expression the brows should be pulled up, but the remainder of the face should stay as still as possible.
Sneer	Wrinkle the nose (as for a disgusted expression) and move the brows down, similar to the central part of the angry expression.
JawLeft	Move the jaw to the left, without opening the lips.
JawRight	Move the jaw to the right, without opening the lips.
JawFront	Move the jaw to the front, without opening the lips.
MouthLeft	Pull the mouth to the left.
MouthRight	Pull the mouth to the right.
Dimple	As in a smile, but without rasining the mouth corners.
ChinRaise	Move the mouth towards the nose.
Kiss	A kiss with the lips put together and pushed to the front.
Funnel	Similar to kiss, but with an open mouth.
Frown	As for an unhappy face with the mouth corners down.
M	Rolling the lips in, as it happens when pronoucing an exaggerated "m".
Teeth	An expression where the actor shows their teeth by lifting/lowering the upper/lower lip and stretching the mouth corners.
Puff	Blowing out the cheeks.
BrowsCenterUp	Raise the center of your eyebrows like for a sad expression.
Stretch	Stretch your mouth corners as much as possible to the opposite sides. Different from dimple.
LipLowerDown	Lower your lower lip without opening the jaw or moving the mouth corners.
LipUpperUp	Raise your upper lip without opening the jaw or moving the mouth corners.
EyeUp	Looking up.
EyeDown	Looking down.
EyeOpen	Open your eyes wide as for a surprised expression.
EyeSquint	Move your lower eyelids up.
EyeBlink	Close your eyes.
Chew2	Open the jaw but keep the mouth closed.
MouthPress	Press your lips.

Table 3.2: Training Expressions in faceshift studio



## 4. Tracking

The tracking mode is used for live tracking, with the possibility to stream the tracked data directly to other programs, and to record clips which can be further improved and then exported or streamed to a target application.

[Tutorial - Tracking Overview](#)

### 4.1 Overview

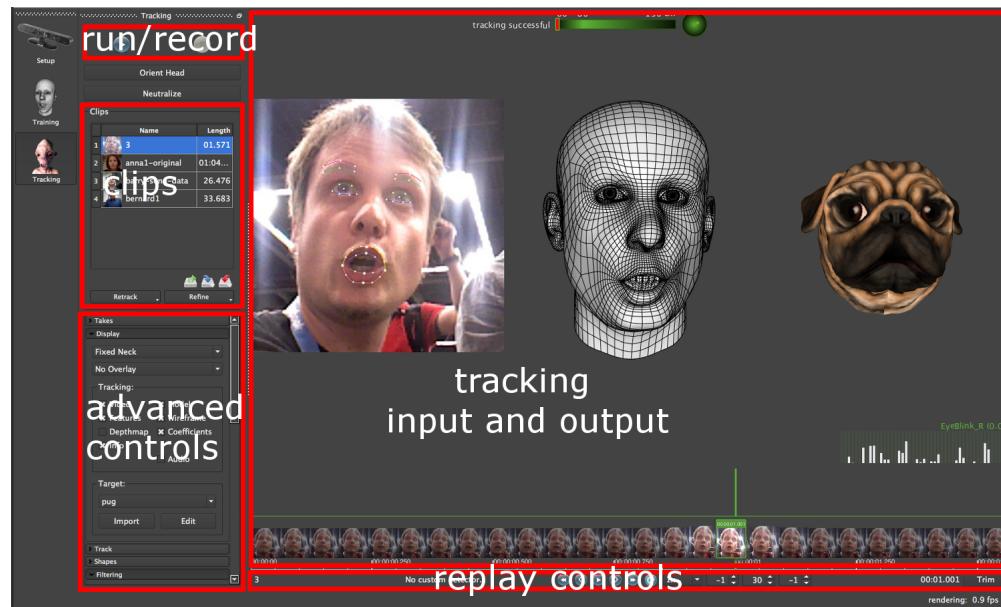


Figure 4.1: The Tracking module

The window is split up as shown in the screenshot: the main display in the middle shows the data that is captured by the camera as well as the tracking output computed by faceshift studio. On the left, you have the controls to start and stop the tracking and recording, and the list of currently open clips along with buttons to open, save, or export them. On the lower left you can

see several panels with additional options.

Below the central display, you will find the replay controls for recorded clips.

This video tutorial explains the meaning of various display options:

[Tutorial - Tracking Display](#)

This video tutorial explains the meaning of the eyegaze options:

[Tutorial - Tracking Eyegaze](#)

## 4.2 Live Tracking



In tracking mode, you can start the live tracking by pressing the **Run** button in the top left corner, which will then change into a **Pause** button. When you switch to tracking from another mode, faceshift studio will automatically start the live tracking. Some preferences influencing the tracking are explained in the Tracking settings (see section 5.3).

### 4.2.1 Blendshape Display

When the **Coefficients** checkbox is checked in the "Display" section of the tracking module, you can see how each blendshape (see section 3.4) is activated during live tracking. This can be used to control that the tracking is accurate; for example, the blendshape JawOpen should be activated when you open your mouth. If the mouth is opened as widely as you did during training, the activation should be full, conversely, a smaller aperture of the jaw should result in a lower activation value.

Clicking on one blendshape will color it in dark green and show you its corresponding curve. Hovering the mouse over another blendshape will color it in light green and show you its curve as well. This can give you a good overview of what is happening during tracking and allows you to analyze the quality of it.

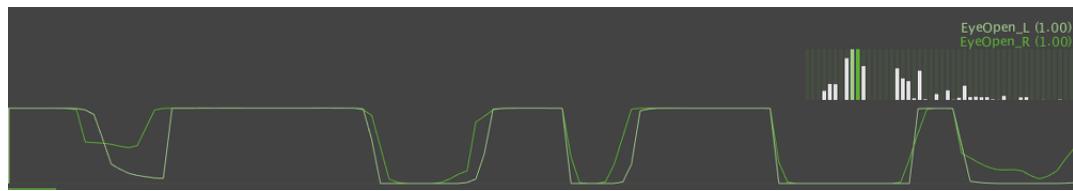


Figure 4.2: Blendshape coefficients display

### 4.2.2 Orient Head

To tell faceshift studio that you are looking straight ahead, click the **Orient Head** button. This will store the current pose as neutral and align the displayed head accordingly. You can set the neutral head pose at any time, also for recorded clips.

### 4.2.3 Neutralize

The **Neutralize** feature uses a range of frames to estimate a new Neutral expression and rebuilds your tracking rig. During live tracking, it will use the next few frames (keep a neutral face!); when called on a recorded clip it, will use the current frame selection (see 4.3.4). You can use this feature when you realize that making a neutral face still activates some blendshapes when they should all be set to 0 (see figure 4.1). This does **not** update your training profile, i.e., as soon as you go back to the Training module, the tracking rig will be reset to the profile you have built from your scans.

Also, please note that some Eye blendshapes are not neutralized (i.e., the ones defining the eye gaze like EyeUp and EyeDown). This is the reason why you can still see some activated blendshapes in the coefficient display.

Have a look at this quick tutorial about how to use the neutralize functionality live or in a clip:

[Tutorial - Neutralize](#)

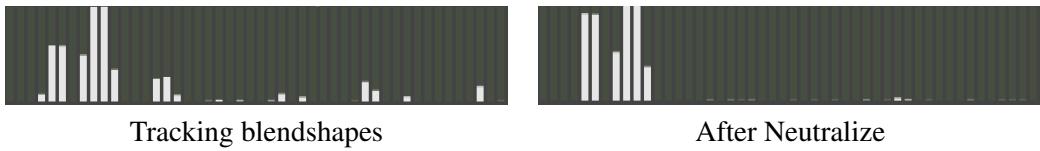


Table 4.1: Neutralize feature. Notice how the blendshape activations are pulled towards zero after the neutralize button was hit. The few bars which did not change represent some not affected eye blendshapes.

### 4.2.4 Recording



When you are ready to record a clip, press the red **Record** button. It is only enabled once the live tracking is running. When you click it, it will light up to indicate that you are recording. You will also notice a red label replacing the replay controls, and that the frame counter and recorded time in the lower right corner of the window start running. Press the button again to stop recording. The new clip will be added to the list on the left.



Figure 4.3: Recording label

If the tracking could not keep up with the frame rate and some frames had to be left unprocessed, a dialog will pop up, asking you to retrack the clip. This will simply reprocess the recorded data as if you were tracking it live. You can also retrack a clip at any time by pressing the **Retrack** button below the list of clips (see section 4.3.1).

[Tutorial - Tracking Recording](#)

## 4.3 Clips

To load a new clip, select "Load Clip" in the main file menu. You can load more than one clip at the same time by using the shift or the control key in the file dialog, dragging and dropping of

multiple clips from your file manager is also supported.

The list on the left of the tracking window shows the currently open clips. By right clicking, you can **save** or **export** them to various formats (see 6). You can also duplicate or delete them from the list. Double clicking a clip will allow you to rename it.

The buttons below the list can be used to open and save the clips in faceshift studio's own \*.fsp format as well as formats supported by other software such as C3D or BVH. There are also the **Retrack** and **Refine** buttons.

#### 4.3.1 Retrack

Retrack will simply reprocess the recorded data as if you were tracking it live. If the currently loaded actor profile is not the same as the one stored in the clip, faceshift studio will ask you which one of the two you want to use. Your selection will then overwrite the previous one within the clip. Holding down the button allows you to choose to retrack all currently loaded clips in sequence, in that case faceshift studio will not ask you if the profiles don't match, and the one stored in each clip will always be used.

Retrack and refine can also be used on a portion of a clip:

[Tutorial - Refine/Retrack Ranges](#)

#### 4.3.2 Refine

Refine will apply more advanced processing, resulting in a smoother, higher-quality clip; however, the refinement process takes considerably more time. For more information about post processing clips, including manual user input for improving facial feature detections, see section 4.3.5. Holding down the button allows you to choose to refine all currently loaded clips in sequence.

[Tutorial - Tracking Refinement](#)

#### 4.3.3 Replay Controls

To play a clip, you can use the controls at the bottom of the window. The buttons in the middle control the replay just like a media player. Besides that, the panel displays the clip name as well as the current frame's index and timestamp relative to the first frame. You can also use the **space bar** to toggle the replay. The **left/right arrow** keys can be used to jump by single frames, or by larger steps if you also hold **Control**.

#### 4.3.4 Timeline

It is also possible to browse through the clip by clicking on or dragging the mouse over the timeline (the row of image thumbnails) or the blendshape curves. By using the right mouse button and dragging, you can select a subsequence of the clip and remove the frames outside of it by clicking the **Trim** button. Using the **left/right arrow** keys while holding "**Shift**" will change the selection. You can also set the start and end frame of the selection by pressing the "**S**" (start) and "**E**" (end) keys, or using the input fields next to the replay controls. See figure 4.4, where the red and yellow input fields are respectively the starting and ending frame for the selection. The green input field corresponds to the current frame.

The same display for the blendshape coefficients is also available for clips (see 4.2.1). Additionally, you can display the audio of your recorded clip by selecting the "Audio" checkbox in the display options.

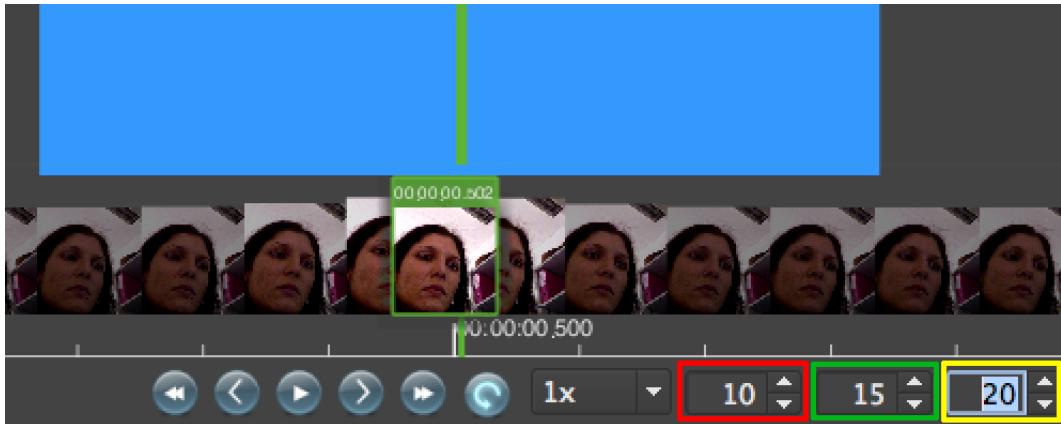


Figure 4.4: Timeline



Figure 4.5: Audio Display

#### 4.3.5 Post Processing a Clip

To achieve the best quality of tracking and animation, recorded clips can be processed further after tracking, with a more accurate and thorough procedure, resulting in a smoother, higher-quality clip, at the cost of more processing time. You also have the possibility to improve the automatically detected facial feature locations wherever needed by manually dragging feature points for the mouth, eyes, and eyebrows.

##### Manual Feature Refinement

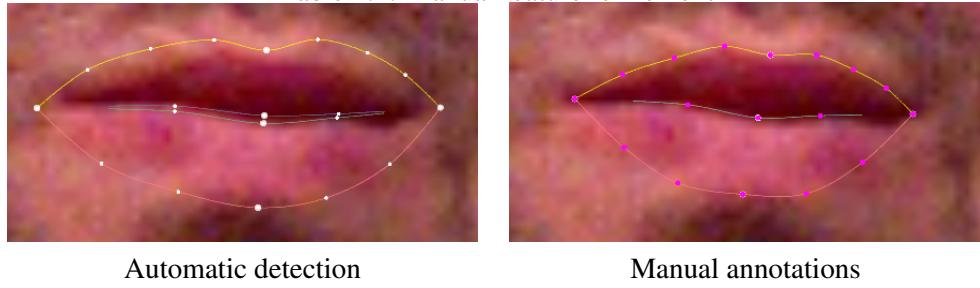
Having recorded (or retracked) a clip, the automatically detected facial features (eyebrows, eyes, and mouth) might not always be perfectly located. In such cases you can manually click the single feature points and drag them to more satisfactory locations.

Whenever you click a feature point, the whole set of points turns magenta, indicating that this feature was manually marked for the current frame. Use the mouse scroll to zoom in on the video frame. To move the frame around, move the cursor away from any facial features, and drag by holding the left mouse button.

As soon as you start marking feature points, faceshift studio automatically starts adapting the clip at hand and refines the location of such feature points in the neighboring frames. Therefore you should not have to manually edit every single frame. The processing is reflected by the progress bar in the bottom right corner of the application. However you do not have to wait for the processing to finish before you can continue – when you are done annotating the clip you should run a refinement on the full clip anyway.

For the eyes and the mouth regions you can indicate that the feature should be closed by clicking or hovering over one of the points of the desired feature and then hitting the "C" (close) key. To delete the current annotation, click or hover over the desired feature and press the "R" (reset) key, the feature will then be automatically detected again in a couple of seconds (the points will

Table 4.2: Manual feature refinement



Automatic detection

Manual annotations

turn white again). To quickly reach the next or previous manually annotated frame, press the "K" or "J" key, respectively. You can also click the pink markers in the timeline, which indicate all manually annotated frames.



Figure 4.6: Manually annotated frames are indicated by these clickable pink triangles

### Refining a Clip

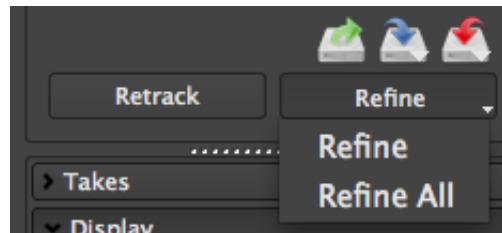


Figure 4.7: Refine a Clip

The **Refine** button is found below the list of currently loaded clips. When clicked, faceshift studio will apply more advanced processing, taking into account both past and future frames, resulting in a smoother, higher-quality clip, at the price of longer computation time. By holding the button, you have the option to refine all currently loaded clips, one after the other, which is useful for overnight processing. Settings can be found in the Preferences menu, and are explained in the Post Processing Settings (see section 5.4).

Refining a sequence will perform the following steps:

- More accurate tracking of the head pose
- Redetection of facial features in the video frames, by creating custom models for the clip at hand, taking into account manually marked feature points
- More accurate tracking of facial expressions in multiple passes



Performing a **retrack** on a clip will not affect the manually annotated features.

## 4.4 Filtering Presets

Since version 1.2, faceshift studio allows you to freely configure the filtering that is applied to your clips as post-processing.

Filters are applied during live tracking, and to the currently selected clip in replay mode. Depending on the filters and the clip's length, you may briefly see a progress bar appearing in the bottom right corner of the application window when you click a different clip, causing faceshift studio to apply the filters to display it.

What is being displayed in the main window is the filtered clip. Likewise, when you export the data to one of the various available formats, the filtered clip will be used. However, when you save a clip in faceshift's own \*.fsp format, it will store the unfiltered data, along with the filtering settings that are currently set to it.

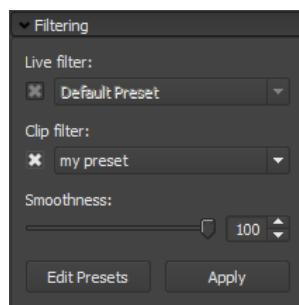


Figure 4.8: Filtering panel

In the filtering panel of main window, you can choose a filter preset for the current performance. You can also switch it on and off conveniently by checking and unchecking the check box.

You will notice that the selected filter for live tracking will be reverted to the default whenever you pause and restart the live tracking (you can choose a different default preset for live tracking in the presets dialog as described below). Similarly, the default preset for clips will be applied when you finish recording a clip or when you load a clip that was saved with a version of faceshift studio prior to 1.2.

There is also a **Smoothness** slider that allows you to control the overall smoothness of the filters contained in the preset – pull it to the left for less, right for more smoothing.

Note that the smoothness parameter as well as the selected preset are saved on a per-clip basis. The **Edit Presets** button opens the presets dialog, where you can customize your filters.

### 4.4.1 Preset Management

Using this dialog, you can add new presets, modify them, and import or export them to a file. You can add a new, empty preset by hitting **New Preset**, or you can select a preset from the combo box. You can change the preset name by typing in a new one in the field below the combo box.

When you try to **Delete** a preset that is still used by some clips, a confirmation dialog will pop up. If you choose to delete it anyway, all clips that use it will be changed to use no preset at all. You can also **Save** and **Load** presets to and from \*.fsf files.

By default, faceshift studio will remember a preset when the application is closed so you do not need to save it explicitly. If you do not want it to keep a preset, simply uncheck the "Load on next startup" box.

Clicking the **Use for Current** button applies this preset to the currently selected clip.

The **Use as default** checkboxes control which preset will be used during live tracking or when you stop recording a clip, respectively. Each of them can only be checked for a single preset. If

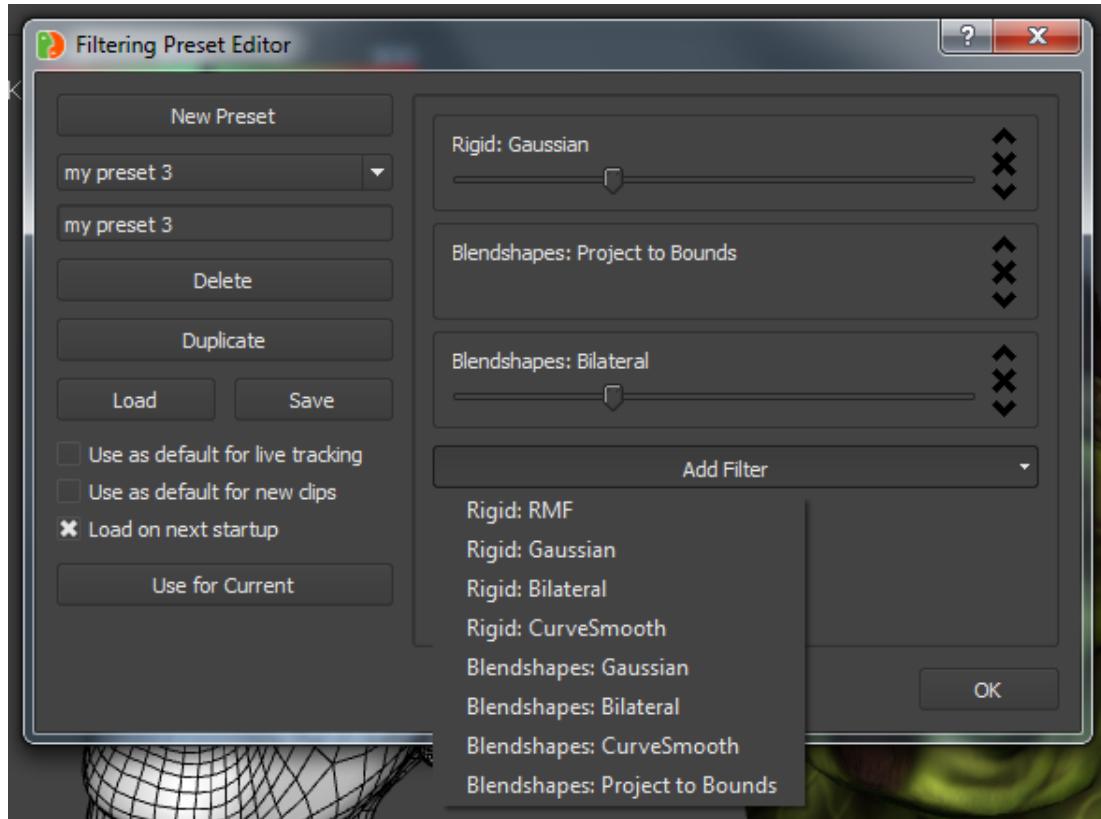


Figure 4.9: Filtering preset editor

you do not want any filtering to be applied to your new clips, make sure that the corresponding checkbox is disabled on all presets (to do that, you can simply check it and uncheck it again on one preset since it cannot be set on multiple presets).

#### 4.4.2 Filters

On the right half of the dialog, you can configure the filters that make up the individual presets. They are applied to the tracking result one after another, from top to bottom. The ordering of the filters can be changed using the up/down arrows on the right, and a filter can be removed from the preset by pressing its X button. Most filters come with a smoothness slider that allows you to change how strongly the result will be smoothed; pulling it to the right will produce smoother results.

There are two basic types of filters: **Rigid filters** affect the alignment of the head, i.e., its position and orientation, while **Blendshape filters** affect the blendshapes, i.e., the way the face is deformed. Faceshift studio currently offers the following filters:

- **Rigid: RMF** (rigid motion filter) is a simple, fast filter.
- **Rigid/Blendshapes: Gaussian** applies Gaussian filtering.
- **Rigid/Blendshapes: Bilateral** applies Bilateral filtering. It is similar to Gaussian, but applies less smoothing to large, sudden changes.
- **Rigid/Blendshapes: CurveSmooth** fits a smooth curve through the coefficients. It yields good results, but it is a little more expensive to compute than Gaussian or Bilateral filtering.
- **Blendshapes: Project to Bounds** is a special filter that does not actually smooth the data. Instead it will fit bounded coefficients to the geometry. Consequently it will not have

any effect if your coefficients are already bounded. It is also computationally expensive, making it the slowest filter currently offered by faceshift studio.

#### 4.4.3 Loading Clips

When you load a clip that was saved with a filter preset, faceshift studio will look for the saved preset in your list. If it finds a preset that consists of the same set of filters with the same smoothness values, it will use that preset. Otherwise, the preset will be added. Faceshift studio may rename the preset to something like "Loaded Preset 003", or it might append an asterisk (\*) to the preset name. Presets loaded this way have the "Load on next startup" flag disabled by default.

### 4.5 Advanced Controls

#### 4.5.1 Takes

Since version 1.2, faceshift studio allows you to conveniently record multiple takes of a single scene. To do that, hit the **Record Takes** button. You will be asked for a name of your scene and a folder to save your clips.

As long as the Record Takes option is enabled, faceshift studio will name and number your recorded clips automatically. When you stop recording a clip, it will be saved to the given folder (if you have the "Save Automatically" checkbox enabled) and faceshift will go back to live tracking. You still need to start the next recording by clicking the **Record** button, though.

To stop treating your clips as takes of the same scene, click the Record Takes button again, but be aware that faceshift will no longer save them automatically when it is off.

#### 4.5.2 Display

The Display settings control what is being shown in the main window.

The first combo box controls how the personalized model and the target character's head will be moving, according to the actor's own rigid head motion:

- **Fixed** keeps the head unmoving at the same position, actually removing the actor's rigid motion. This view can be useful to look at fine facial deformations.
- **Fixed Neck** keeps the neck at the same position, but turns the head according to the actor's movement.
- **Floating** will make the head move ("float") through space as the actor moves.

Using the second combo box, you can overlay the personalized actor model or the current target over the video image.

The set of checkboxes allow you to enable or disable various displays:

- **Video** toggles the display of the image captured by the sensor.
- **Features** toggles the rendering of the detected eyes, eyebrows, and mouth features over the video.
- **Depthmap** toggles the display of the depth data captured by the sensor. It is often a good idea to look at the depth data since moving too close to the camera often produces holes in the depth map, causing bad results.
- **Info** toggles the "Tracking OK/failed", distance and orientation displays at the top of the window.

- **Model** toggles the display of the actor's trained model.
- **Wireframe** toggles the rendering of the model's edges, which allows you to see deformations more clearly.
- **Coefficients** toggles the display of the blendshape coefficients (curves and bar diagram) at the bottom of the window (see section 4.3.4).
- **Audio** toggles the display of the audio waveform.
- **Timeline** toggles the display of the thumbnails and time chart at the bottom of the window.

You can also apply the tracked data to a predefined target character by selecting a target from the **Target** combo box. Please refer to FBX Target Import (see chapter 6) to learn how to display your own model within faceshift studio.

#### 4.5.3 Track

The Track panel controls some basic settings for the processing. More advanced parameters can be found in the Preferences. Note that if you are working with a recorded clip, these settings will not have any effect unless you retrack or refine the clip.

The **Deformation** checkbox allows you to turn off the tracking of facial expressions. If it is off, only the head position and orientation will be tracked, but not the blendshapes. If your machine is often struggling to process the data at the camera's frame rate, you may notice that turning Deformation off makes it easier for the tracking to keep up.

The **Bounds** combo box allows you to change how the blendshapes are tracked. If you use the **Bounded** setting, the blendshape coefficients will be constrained to be between 0 and 1 (by default). You can manually adjust the bounds on a per-shape basis using the Shapes panel, which also allows you to turn off the tracking of individual shapes (see section 4.5.4). The **Unbounded** setting allows the coefficients to take arbitrary values, resulting in values that may not be practical by themselves. However, this setting allows the scanned geometry to be matched more closely, therefore it is particularly useful (and recommended) if you intend to export the performance as virtual markers.

The **Geometry-Texture** slider allows you to control how strongly the data captured by the depth/video sensors influence the tracking results. If you are tracking under bad lighting conditions, we recommend pulling the slider towards Geometry.

The **Brow** and **Mouth Smoothing** sliders allow you to change the smoothing applied to the brow and mouth blendshapes, respectively.

#### 4.5.4 Shapes

In addition to filter presets (see section 4.4), it is possible to use shape presets to influence the tracking result. You can choose a maximum coefficient value for each blendshape used for tracking, depending on the result you would like to achieve. For example, setting a blendshape to 0 will disable it completely for the tracking.

Note that modifying a preset or selecting a different one will not change existing clips. You have to retrack or refine the clip to see the effect. This applies only to recorded clips; if you are tracking in live mode, you will be able to see changes to the active preset immediately.

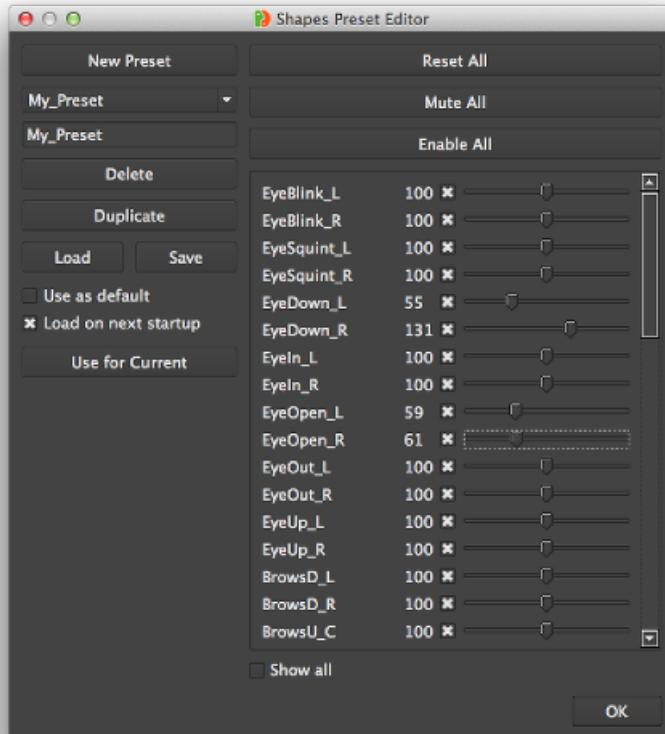


Figure 4.10: Shape preset editor

#### 4.5.5 Filtering

These settings are described in section 4.4.

#### 4.5.6 Eyes

These settings allow you to control the eye tracking:

- **Eye Tracking** allows you to disable the eye tracking, assuming a "straight ahead" eye gaze.
- **Couple Eyes** assumes the same eye gaze for both eyes.
- **Couple Eyelids** forces the eyelids to behave similarly, consequently you will only be able to track winking correctly if this is off.

#### 4.5.7 Features

The detection of eye, eyebrow, and mouth features in faceshift studio is based on a detector that was trained from manually annotated data.

The **Create** button in the Features panel allows you to train a custom detector from all clips that are currently loaded. Your custom detector will then be used for the feature detection on subsequent tracks. You can also **Save** and **Load** custom detectors, and you can restore the original, built-in detector using the **Reset** button.

Note that an additional label in the Replay Controls (see section 4.3.3) tells you which custom

detector is currently loaded.

#### 4.5.8 Network

The **Network Streaming** checkbox allows you to send the tracked data over the network. Please note that the freelance version of faceshift studio does not support network streaming during live tracking. You can also use faceshift studio to receive tracking data from a remote instance of the application using the **Connect to Server** button.

Configuration parameters for the network streaming can be found in the Streaming section of the Preferences (see section [5.5](#)).

For learning how to use faceshift studio with Unity, Maya, and MotionBuilder, see chapters [10](#), [11](#), and [12](#). To learn how to process the streamed data in your own application, please refer to the faceshift networking section [6.6](#).



## 5. Settings

### 5.1 Import/Export Settings

All the settings of faceshift studio are saved in a single file called "faceshift.ini" located in the faceshift studio workspace. In the application menu you have the possibility to **export** the current settings to a different ".ini" file. This new file is basically a copy of "faceshift.ini" which always holds the current settings state. When **importing** existing ".ini" files, the current settings will be replaced. The **Reset** option enables you to retrieve the default values of all the settings.

Note that filter and bounds presets are not completely replaced because the existing ones might be used by some clips and need to stay in the preset lists. The imported presets will simply be added to the current ones. The existing presets are only kept temporarily and will not be saved automatically.

## 5.2 General Preferences

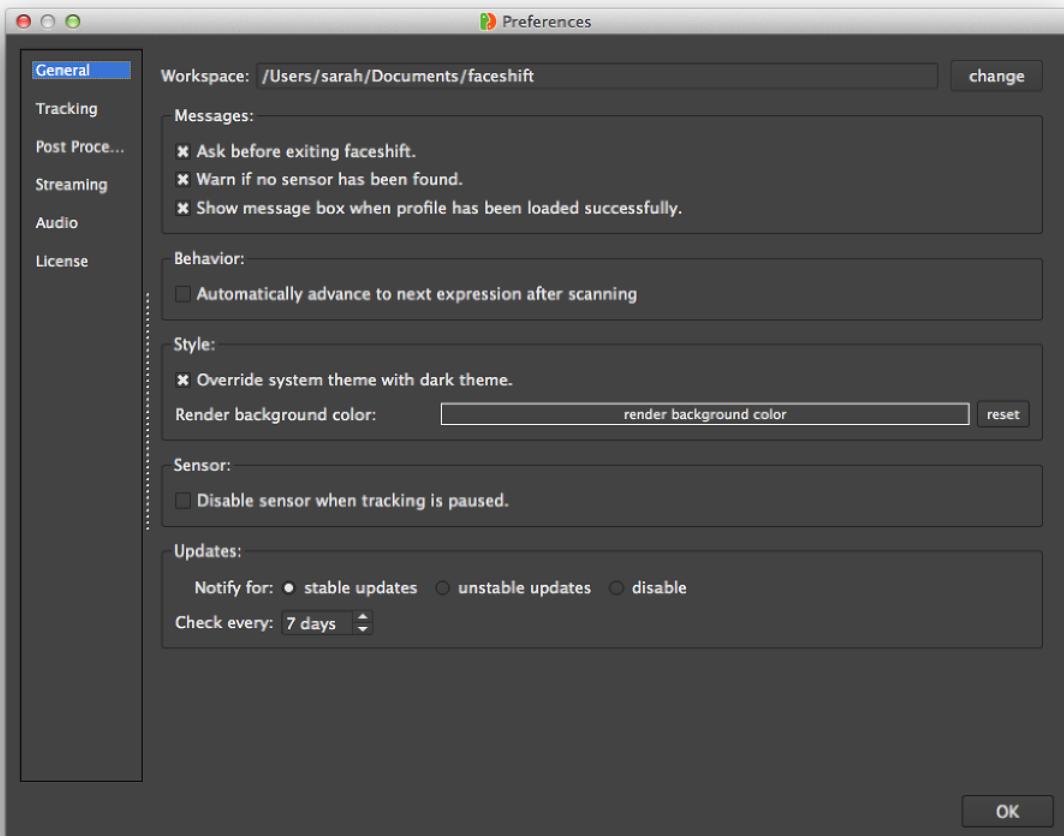


Figure 5.1: General Preferences dialog

This tab shows you some general settings. Here you can:

- Display and change the current workspace used by faceshift studio. This is the directory where the application stores actor profiles and recorded clips, but also the faceshift studio license and log data.
- Individually enable/disable pop-up messages/warnings
- Change the style of the user interface
- Select whether the sensor should be turned off when faceshift is not using it. Note that the sensor will not be turned off immediately when you pause the tracking, but only after a moment of inactivity.
- Select which kind of updates you want to be notified about, and how frequently the auto-update tool should check for new updates.

## 5.3 Tracking Preferences

These settings apply to both the live tracking and the offline retracking, achieved when the Retrack button is pressed (see section 4.3.1).

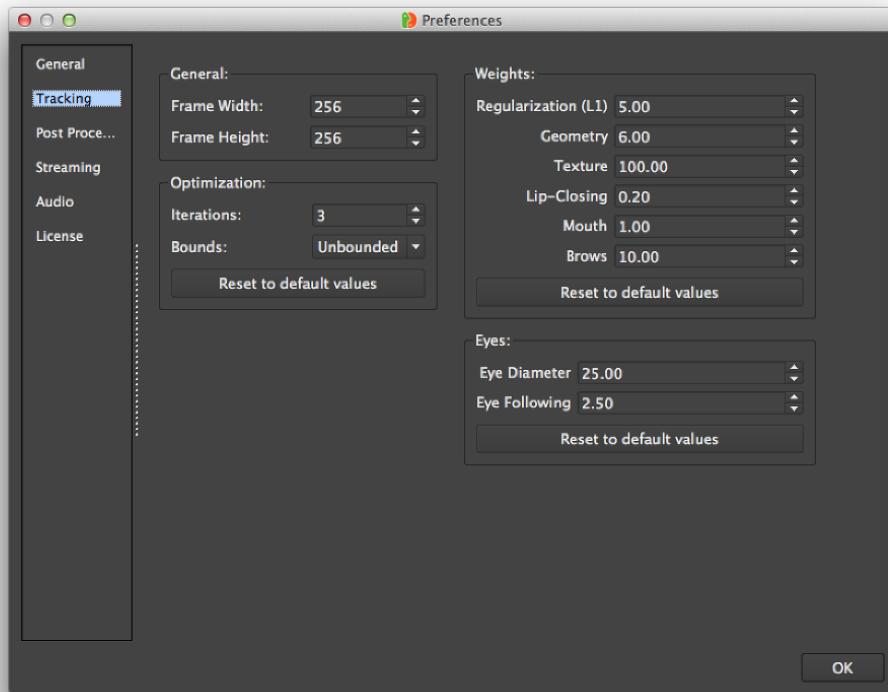


Figure 5.2: Tracking Preferences dialog

Check out how to influence of the various tracking settings on the performance:  
[Tutorial - Tracking Settings](#)

### 5.3.1 General

- **Frame Width/Height** - Size of the image region cropped around the tracked face. Smaller values can slightly improve performance and produce smaller files when recording.

### 5.3.2 Optimization

- **Iterations** - Set the number of optimization iterations performed during tracking. Values larger than 4 do not produce noticeable gain.
- **Bounds** - This is the same setting as in the Track panel of the main window. Use Bounded when retargeting blendshapes; use Unbounded tracking when exporting virtual markers.

### 5.3.3 Weights

- **Regularization** - Pull blendshape coefficients towards zero. An increased value creates sparser blendshape curves, but results in less accurate tracking.
- **Geometry/Texture** - Weight given to the depth/video data for tracking.
- **Lip-Closing** - Higher values prefer closed lips when detected in depth and video image.
- **Brow/Mouth Features** - Weight of the eyebrows/mouth feature detections from the video.

- **Eye diameter** - Used to compute the eye gaze direction given the tracked pupil position.
- **Eye Following** - Higher values activate the eye blendshapes more with respect to the tracked eye gaze.

## 5.4 Post-Processing Preferences

These settings apply to the post processing of recorded clips, i.e., when the **Refine** button is clicked (see section 4.3.5).

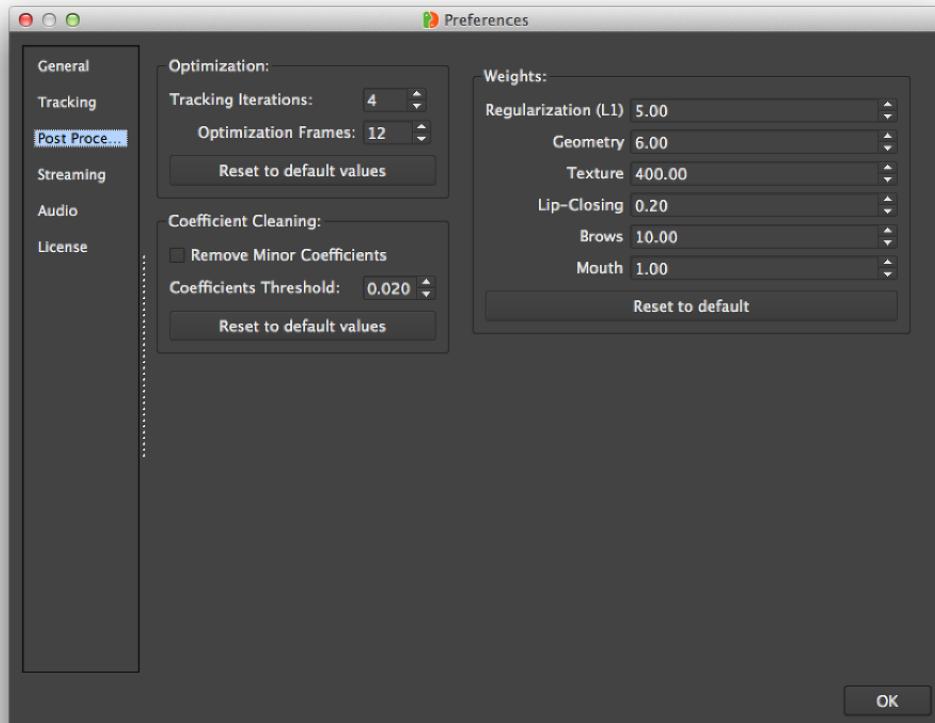


Figure 5.3: Post Processing Preferences dialog

### 5.4.1 Optimization

- **Tracking Iterations** - Set the number of optimization iterations performed during tracking.
- **Optimization Frames** - Number of frames taken into account for optimization.

### 5.4.2 Coefficient Cleaning

- **Remove Minor Coefficients** - Check to remove blendshape coefficients smaller than a threshold.
- **Coefficients Threshold** - Change the threshold for defining the coefficients to be removed.

### 5.4.3 Weights

This is the same set of parameters as for live tracking. Please refer to the Tracking Preferences (section 5.3) to learn about their effects.

## 5.5 Streaming Preferences

These settings control the streaming output to a remote machine.

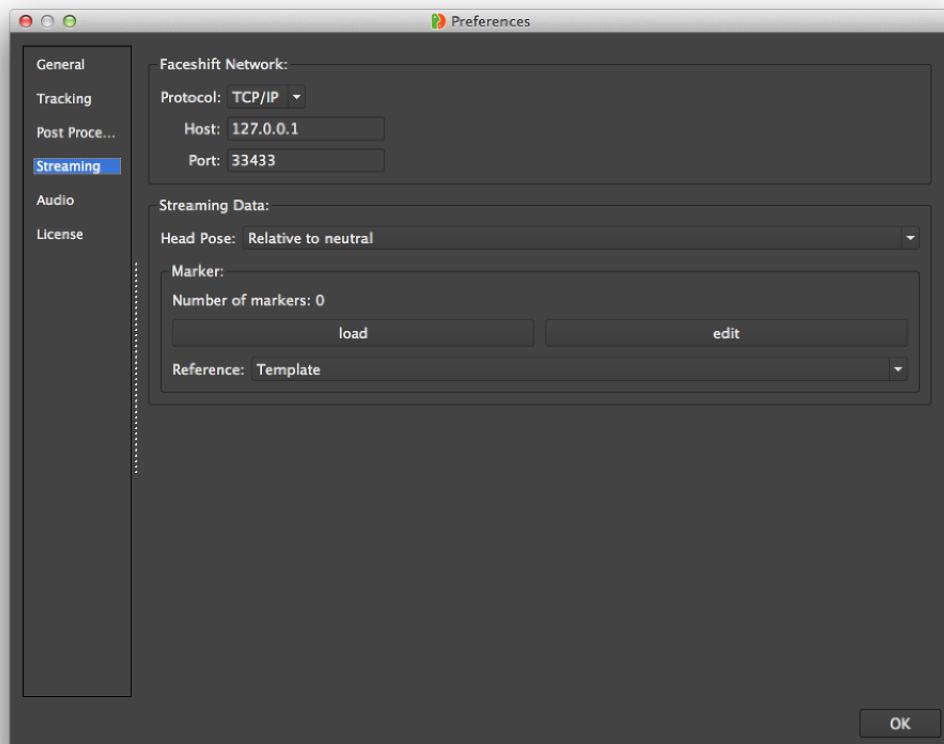


Figure 5.4: Streaming Preferences dialog

### 5.5.1 Network

- Protocol, IP address, and port of the destination

### 5.5.2 Streaming Data

- **Head Pose** - Select whether the head pose should be streamed in relative or absolute orientation. "Relative to neutral" streams it with respect to the neutral pose set by the Orient Head button, "Absolute" streams it with respect to the sensor, i.e., the sensor is at the origin.
- **Markers** - use the buttons to load and edit the set of virtual markers whose coordinates should be used for streaming. You can learn more about virtual markers in sections 3.6 and 6.1.
- **Reference** - defines which shape will be used to compute the marker positions, the actor-independent Template model or the Actor model that is used for tracking.

## 5.6 Audio Preferences

These settings control the audio in- and output. They allow you to select the quality of the audio recording (number of channels and sample rate) and which devices to use for input/output.

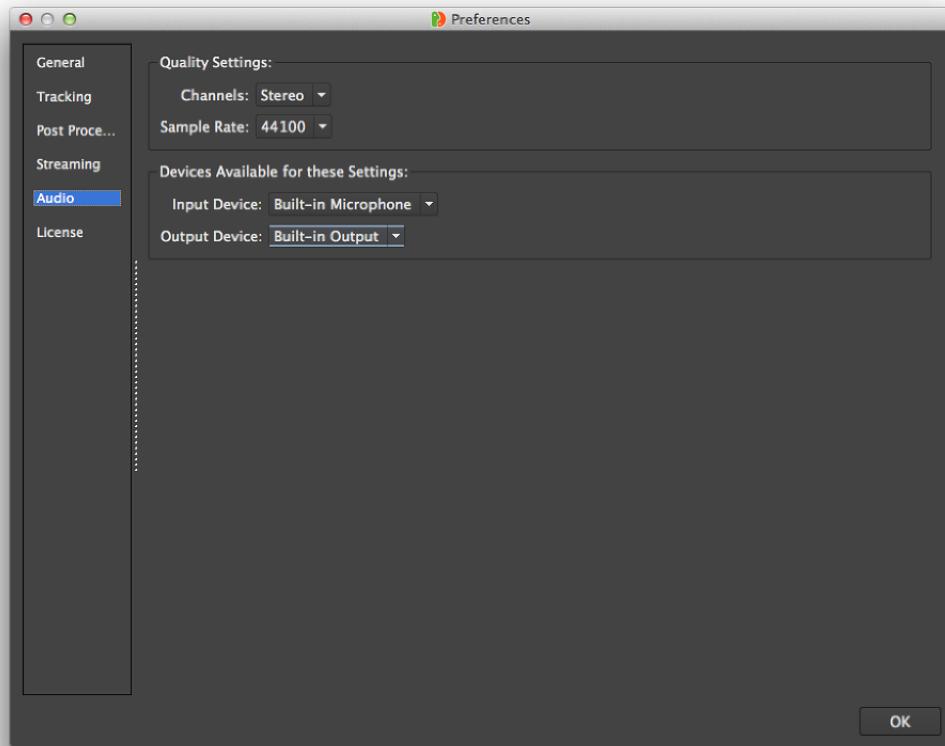


Figure 5.5: Audio Preferences dialog

## 5.7 License Preferences

See section [1.4](#).



## 6. Interfacing with Other Applications

We support a number of animation packages via different routes.

	Autodesk Maya	Autodesk Motion Builder	Autodesk Softimage/FaceRobot	Autodesk 3DS Max	Blender	Maxon Cinema4D	Custom Tools
<b>plugin</b>	plugin with integrated retargeting	plugin generating a virtual device				open source plugin	
<b>virtual markers</b>		bvh and c3d format	c3d format	bvh format	c3d and bvh format	bvh format	bvh, c3d, fsopen
<b>blendshapes / morph targets</b>	fbx format	fbx format, bvh format		fbx format		fbx format	fbx, bvh, fsopen
<b>tcp/ip stream</b>	<sup>1</sup>	<sup>1</sup>					networking interface

Figure 6.1: Compatibility Matrix

<sup>1</sup> The plugins receive the data over a TCP/IP network stream, so it is also possible to stream to a different computer.

### 6.1 Export of Virtual Markers

One of the main advantages of faceshift studio is that it is **marker-less**. Nevertheless, there are many animation pipelines that work with marker-based motion capture solutions, and we therefore provide ways to export **virtual** markers. Faceshift studio supports marker export in c3d format, bvh format, and in our own fs open format (binary or ascii), see section 6.7. The c3d format is compatible with Autodesk Softimage/FaceRobot, Autodesk MotionBuilder, and

Blender. The bvh format is compatible with Blender and many other packages. The export options are the same for all four formats.

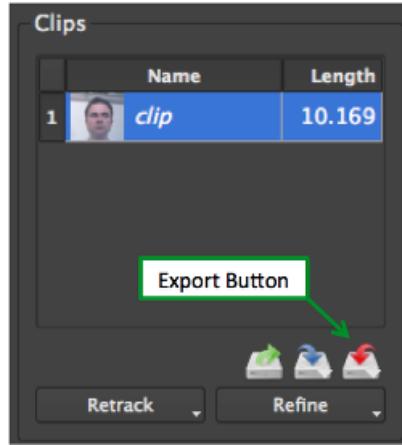


Figure 6.2: Export of Clips

To export a virtual marker set:

1. Select a clip.
2. Press the **Export** button.
3. Choose the export format (c3d, bvh, or fs open format).
4. Choose the output file.
5. Configure the marker set output and other options in the panel on the right (see below).
6. Save the file.



Figure 6.3: Export Menu

This tutorial shows you how to export virtual markers via c3d or bvh:

[Tutorial - Marker Export](#)

### 6.1.1 Export Configuration

1. Choose a marker set.
  - none: do not export markers (only relevant for fs open format export)
  - facerobot: an Autodesk Softimage/FaceRobot compatible marker set
  - load...: load a marker file
  - custom...: a custom marker set

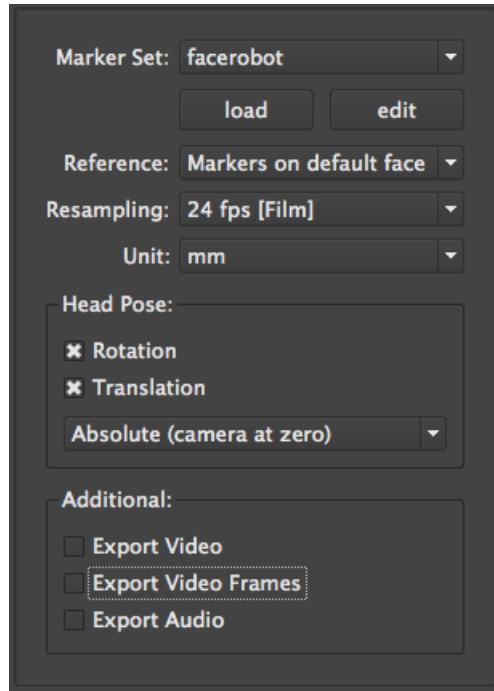


Figure 6.4: Export Dialog

2. Press **Edit** to edit the marker set (see section 3.6).
3. Choose reference: virtual markers are either exported as markers on the default rig (default face) or on the personalized rig of the user (actor face).
4. Choose framerate: the sequence is resampled accordingly. Native does not perform resampling and uses the frames as they were captured during tracking, i.e., at an irregular frame rate.
5. Choose unit: the markers are exported in the selected unit.
6. Choose head pose output.
  - define whether to export head pose (rotation and/or translation)
  - the head pose may either be set in absolute coordinates (camera is at center), relative to the neutral pose set using the Orient Head button, or relative to the first frame of the sequence.
7. Choose additional output.
  - check **Export Video** to export the video to a multimedia file (faceshift studio will open a dialog asking for the filename, where you can also set the video compression settings and whether the audio should be included)
  - check **Export Video Frames** to export the video to a jpg image sequence (faceshift studio will ask for the filename and export a sequence of jpg images)
  - check **Export Audio** to export the audio track to a wav file (faceshift studio will ask for the filename)

### 6.1.2 C3D Export

For c3d export, the head pose will be directly applied to the marker values. The eyes are automatically exported as marker positions, one marker for each eyeball center, and one marker for the pupil. The marker names are "ELCT" (eye left center), "ELPP" (eye left pupil), "ERCT" (eye right center), "ERPP" (eye right pupil).

### 6.1.3 BVH Export

The head pose and eye positions/gaze are exported as joints in the hierarchy. Additionally, the blendshape coefficients are also stored as an extra set of joints.

## 6.2 Export of Blendshapes

Blendshape coefficients can be exported in the faceshift text based format, as part of an FBX export (see section 6.3), or as additional bones in the bvh output format.

When you export a clip in BVH format (see section 6.1.3), faceshift will add a set of bones in addition to the virtual markers, where each bone corresponds to a blendshape. This is reflected by the bone names. The blendshape activation between 0 and 1 will be mapped to a rotation between 0 and 90 degrees, as can be seen in this screenshot from Blender:

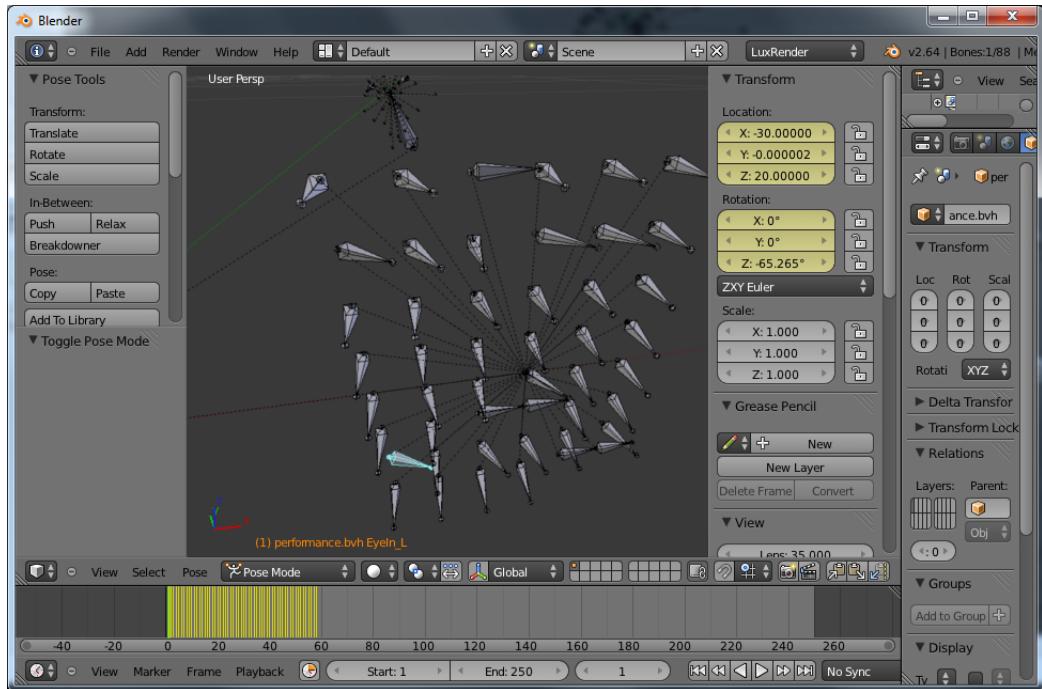


Figure 6.5: Blendshapes in Blender

The current blendshape list can be found in the Tracked Blendshapes section (see section 3.4).

### 6.3 FBX Export

The FBX export dialog is very similar to the marker export dialog (see figure 6.4). Choose your target in the list, the head pose options (should it be relative to neutral, to the first frame or absolute?), the fbx version you want to export for and the format. Additionally, you can export the video data (also as jpg images) and the audio file.

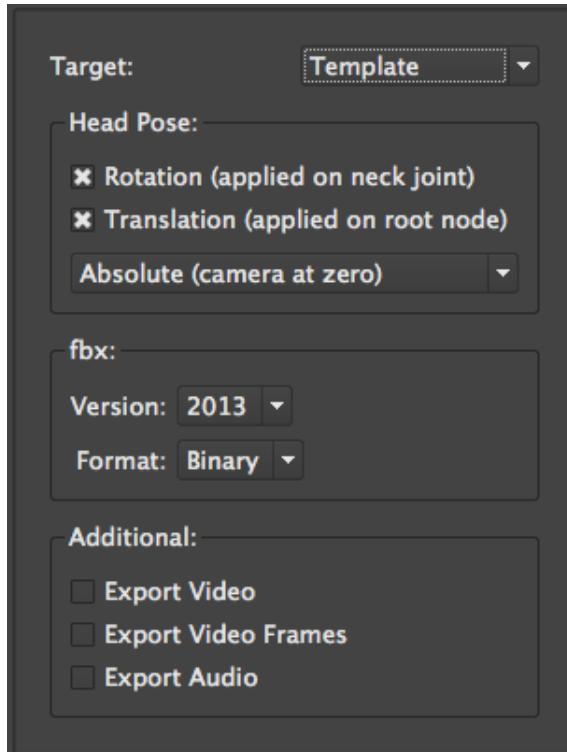


Figure 6.6: FBX Export Dialog

Note the **Export All** option in the main application menu. The same FBX export dialog appears but all your current clips will be exported automatically. If the clips were defined as takes, they will be exported in the take directory that you have defined, otherwise they will be exported in the performances directory of your workspace.

## Tutorial - FBX Export

### 6.4 Export Audio/Video

The video and audio content of a clip can be exported by selecting the corresponding items from the export menu. Moreover, the user can select to export a video containing the sequence of screenshots of the tracking display.

#### 6.4.1 Export Audio

By selecting the corresponding entry in the export menu, the audio content of a clip can be exported into an uncompressed .wav file.

#### 6.4.2 Export Video

The RGB video content of a clip can be saved into a multimedia file (.avi or .mov containers allowed). The video can be resampled to have a fixed framerate, or the frames can be encoded

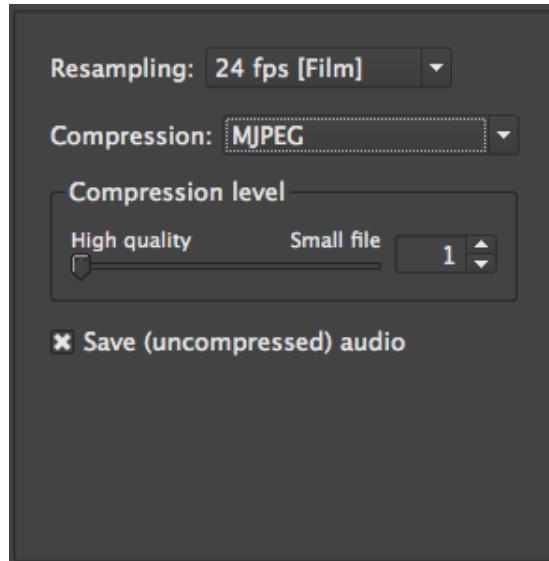


Figure 6.7: Video Export Dialog

using their acquisition timestamps (native). The file can contain an uncompressed RGB stream or an MJPEG (lossy) compression algorithm can be used to reduce the final video size. A slider allows you to find the desired compromise between video quality and size of the file.

#### 6.4.3 Export Video (single frames)

The RGB stream can be exported as a sequence of .jpg images. A dialog asks the user for the name prefix, to which the frame number will be automatically appended. You can also select to resample the video to have a fixed framerate.

#### 6.4.4 Export Video (screenshots)

This action lets you save a videoclip containing screenshots of the tracking, its content reflecting the choices made in the Display tab (see section 4.5.2). The dialog that appears is similar to the one in figure 6.7, letting you select the filename, the compression level, and whether audio should be included. In addition, the video size in pixels can be set, independently of the current window size.

This tutorial shows you how to use the different options of the video export:

[Tutorial - Video Export](#)

## 6.5 FBX Target Import

In addition to writing out different formats, we also allow you to import new characters to be animated into faceshift studio. You can also animate the character and then write the animation out again. Data exchange happen via the FBX file format.

### Tutorial - FBX Import

#### 6.5.1 Requirements

In order to import your own character into faceshift studio, we have the following requirements and limitations:

1. Blendshapes: faceshift studio currently only supports blendshapes to map the facial expressions of the actor face to your imported character. The blendshapes do not need to correspond one-to-one. Instead, you will need to define a combination of blendshape weights on your character for each blendshape of the actor face (see section 3.4) in faceshift studio.
2. Head Pose: to map the head pose onto your character, your character needs to have a neck joint.
3. Eye Gaze: to map the eye gaze onto your character, your character needs to have a joint for each eye.

#### 6.5.2 Import

In the Display tab (see section 4.5.2) you can select different targets for animation. faceshift studio provides a set of default characters, but you can also import your own character via the FBX file format. You will need to create a mapping from the faceshift studio actor face to your own characters. The mapping can be saved, and faceshift studio will automatically list all imported target characters where the created mapping file resides in the target directory of the workspace (see section 5.2). To import a new character, click **Import**, or click **Edit** to modify a previously imported character.

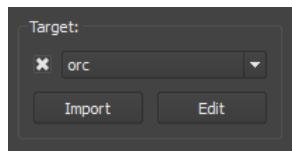


Figure 6.8: Target controls

#### 6.5.3 Mapping

In order to import your own character, you need to create a mapping between the faceshift studio actor face and your target character. Start by loading the FBX file of your character by clicking **New Target**. The left pane should now display your faceshift studio's actor, while the right pane should display your imported character, potentially misaligned and at different scale. You can adapt the alignment and scale using the controls at the top left part of the window. Keep in mind that a global translational alignment between the actor's face and the target character is automatically defined once you map the neck joint of the actor to the neck joint of your own character, so translational alignment should only be set after mapping the joints. You may define a **name** of your imported character (the FBX filename is set by default). In case textures are not displayed correctly, as the FBX file may contain invalid file paths, you can define a default texture directory where the textures of your target character reside.

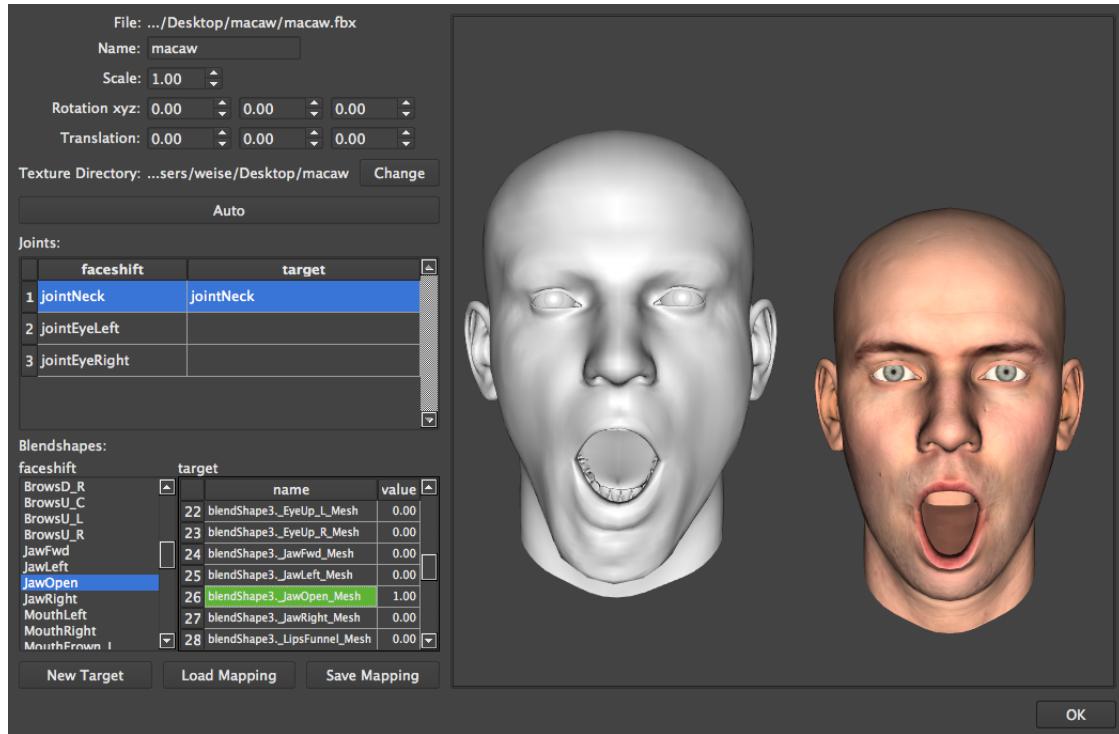


Figure 6.9: Target import dialog

## Joints

Head pose and eye gaze are defined by joints in the actor face. In order to map these to your own target character, your rig also needs to have the corresponding joints. Please select the appropriate joints in your rig for each of the actor face joints. Joints that are not mapped will be ignored, e.g., if you don't map the neck joint, then head pose will not be mapped onto your target character.

## Blendshapes

Expressions are defined via blendshape mapping. For each of the blendshapes of faceshift studio, select and activate the corresponding blendshape(s) on your target character. One blendshape in faceshift studio may be mapped to multiple blendshapes in your target character and vice versa.

## Load/Save

Your mapping may be stored to disk as a text file (.fst file) by clicking **Save Mapping**, and accordingly you can load a previous mapping by clicking **Load Mapping**. In order to have faceshift studio load a mapping by default, save the mapping file to the target directory in your workspace.

## 6.6 Faceshift Networking

Faceshift studio provides a networking module for real-time streaming of the tracking data and for remote controlling faceshift. The communication protocol use the fs binary format via either TCP/IP or UDP. Remote control functionality is only supported in TCP/IP mode.

This video tutorial explains how to export the tracking data in various format via the network:  
[Tutorial - Network & fopen](#)

We offer a generic C++ parser for reading and writing the binary format. Download it from [here](#).

In this section we describe the underlying format, if you want to write your own parser.

### 6.6.1 FS Binary Format

The fs binary format is a hierarchical block-based data structure (in little-endian encoding). A general binary block has the following structure:

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint16	1	block ID	ID
uint16	1	version number	1 (current version)
uint32	1	block payload size	N
	N bytes	block specific payload, see below	

For all binary blocks, the basic data types are encoded in little-endian format. The data type string is encoded as follows:

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint16	1	length of string	L
uint8	L	the ASCII characters	

### 6.6.2 Data Stream

Faceshift studio streams various data blocks over the network. The default stream only consists of the tracking parameters (tracking state) for each frame, the other data blocks may be requested via remote controls (see futher below).

<b>Block ID</b>	<b>Description</b>
33433	Tracking State
33533	Marker Names
33633	Blendshape Names
33733	Rig
55355	Signal (Person detected or leaving)

## Tracking State

(Block ID 33433) The tracking state parameters are a set of sub-blocks that are contained within one single Tracking State block. You can therefore read a full frame by looking for the Block ID of the Tracking State (33433) and then read the full frame. Note that the tracking state is completely described by a single Tracking State data packet, data is not split into multiple Tracking State. An exemplary binary data block is shown further below. The Tracking State block is a binary block containing multiple sub-blocks with individual tracking parameters:

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint16	1	the number of sub-blocks	N
BLOCK	N	(at most one sub-block of each type, see below)	

The Tracking State block contains five different binary sub-blocks:

<b>Block ID</b>	<b>Description</b>
101	Frame Information
102	Pose
103	Blendshape
104	Eyes
105	Markers

The binary block structure for the various tracking parameters follows.

(Block ID 101) Frame Information - contains the timestamp and a flag telling whether tracking was successful for this frame.

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
double	1	timestamp in ms	
uint8	1	flag whether tracking successful	0/1

(Block ID 102) Pose - the head pose as an absolute or relative transformation (depending on the setting). Relative means computed with respect to the head pose of the actor at the time when the "Calibrate Neutral Pose" button was hit.

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
float	4	head pose - rotation in quaternion format (x,y,z,w)	
float	3	head pose - translation (x,y,z)	

(Block ID 103) Blendshapes - the blendshape coefficients for the current frame.

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint32	1	number of coefficients	n
float	n	the coefficients	

(Block ID 104) Eyes - the eye gaze for left and right eye in degrees.

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
float	1	left eye theta (in degrees)	(-90,90) (neg: up, pos: down)
float	1	left eye phi (in degrees)	(-90,90) (neg: right, pos: left)
float	1	right eye theta (in degrees)	(-90,90)
float	1	right eye phi (in degrees)	(-90,90)

(Block ID 105) Markers - the virtual marker positions as set within the application (depending on the setting in faceshift studio).

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint16	1	number of markers	M
float	M*3	marker positions (x, y, z)	

### 6.6.3 Marker Names

(Block ID 33533) The M marker names currently streamed in the Tracking State are sent via network if a "Send marker names" packet is received from the client (see remote control commands below).

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint16	1	number of markers	M
string	M	marker names	

### 6.6.4 Blendshape Names

(Block ID 33633) The N current blendshape names of the coefficients streamed in the Tracking State are sent via network if a "Send blendshape names" packet is received from the client (see remote control commands below).

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint16	1	number of blendshapes	N
string	N	blendshape names	

### 6.6.5 Rig

(Block ID 33733) The current tracking rig is sent via network if a "Send rig" packet is received from the client (see remote control commands below). The rig includes the mesh topology and all blendshapes.

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint32	1	number of quads	Q
uint32	Q*4	quad indices	
uint32	1	number of triangles	T
uint32	T*3	triangle indices	
uint32	1	number of vertices	V
float	V*3	the vertices of the neutral shape (x,y,z)	
uint16	1	number of blendshapes	N
string	N	the blendshape names	
uint16	1	number of blendshapes	N
float	V*3*N	the vertex offsets (x,y,z) of all blendshapes, in the same order as in Tracking State	

### 6.6.6 Signal

(Block ID 55355) Signals correspond to state changes of faceshift studio. Currently implemented signals are "person entered" and "person left".

<b>data type</b>	<b>quantity</b>	<b>description</b>	<b>value</b>
uint32	1	person entered/left	1/0

### 6.6.7 Remote Control

Faceshift studio supports remote control functionality in TCP/IP network mode. The following commands are accepted by faceshift studio (set message size of binary block structure to 0):

<b>Block ID</b>	<b>Description</b>
44344	Start tracking
44444	Stop tracking
44544	Orient Head
44644	Send marker names
44744	Send blendshape names
44844	Send rig
44944	Stream head pose relative to neutral
44945	Stream head pose in absolute position (camera at zero)

## 6.7 Faceshift Open File Format

Tracking data can be exported using the fs open format. When exporting in fs open format (binary or ascii), all tracking parameters and virtual markers are exported.

### 6.7.1 FS BINARY Format

The fs binary format is a hierarchical block-based data structure. The same format is also used for network streaming of the tracking data, therefore the exact format is documented in the network communication section (see section 6.6), along with links to the C++ classes we provide to simplify access.

An exported \*.fsb binary file simply consists of one Blendshape Names block (ID 33633), followed by any number of Tracking State blocks (ID 33433), one for every frame of the clip. Since the format is also used for streaming, the file does not store the number of frames it contains.

### 6.7.2 FS ASCII Format

Faceshift studio supports output as ASCII files. The data is written in a block structure and each block starts with a specific keyword, marked in bold below:

- **FS** numblocks
- **I** timestamp (in ms) trackingSuccess (0 or 1)
- **P** qx qy qz qw (head rotation as quaternion) tx ty tz (head translation in mm) (the head pose coordinate system is defined in the application - absolute or relative)
- **C** numCoefficients v1 v2 ... vn (blendshape coefficients that are tracked in faceshift)
- **E** leftEyePitch leftEyeYaw rightEyePitch rightEyeYaw (in degrees)
- **M** numMarkers x1 y1 z1 ... xm ym zm (the unit depends on the setting in the application)

Two lines of the exemplary format without any markers:

```
FS 5 I 33.3333 1 P -0.000162818 -0.00131751 0.000690874 0.999999 -0.244612
0.0544815 0.0306396 C 46 0.0997361 0.0997361 0.932142 0.932142 0.209866 0.205085
0 0.395189 0 0 0.220958 0 0 0 0.19631 0.345989 0.0517451 0 0 0.0506901 0.0107231
0.0588932 0 0 0.00105792 0 0 0 0.0153362 0 0 0 0.0262555 0.0680846 0.00323772
0 0 0 0.0654269 0 0 0 0 0 0 E -6.02331 6.37829 -5.88561 11.4575 M 0 FS 5
I 66.6667 1 P -7.38358e-06 -0.00308635 0.00197219 0.999993 -0.624882 0.0363846
0.043457 C 46 0.0965532 0.0965532 0.909633 0.909633 0.198588 0.19369 0 0.425377
0 0 0.251909 0 0 0 0.169044 0.295062 0.0402409 0 0 0.0649989 0.000186683 0.180477
0 0 1.84178e-05 0 0 0 0.0266345 0 0 0 0.000457093 0.116282 0.0708589 0 0 0
0 0.0424745 0 0 0 0 0 E -5.69853 7.27203 -5.55754 12.3389 M 0
```

Note that no block is contained for the blendshape names, the ASCII format simply assumes the current set of blendshapes, in order. The list of blendshapes can be found in the Tracked Blendshapes section (see section 3.4).





## 7. Tips & Tricks

### 7.1 Optimize your Sensor Input

Here are some hints how to optimize your sensor input.

#### 7.1.1 Depth data

Try minimizing the amount of holes in the depth data. Holes are usually created due to other light sources (such as the sun) or due to the distance of the actor from the sensor. Sunlight tends to throw off the depth sensors based on infrared projection, causing bad results. If you are working close to a window, try closing the blinds. Ideally, the actor should be at about 60cm distance (depending on the sensor). Make sure not to be too much closer or further away, which may increase the amount of holes.

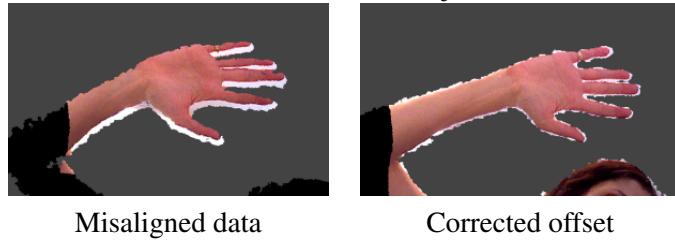
#### 7.1.2 Color data

The lighting should be even, not saturated. If you are using the OpenNI 2 driver, you can use its auto-exposure option to optimize the input. Unfortunately the sensor does not allow direct adjustment of the exposure setting. However, you can avoid over-saturation by tricking the sensor: enable the auto-exposure setting and hold up a sheet of white paper. You will notice the image getting darker to compensate for the brighter input. Then turn off the auto-exposure setting again. You may also be able to achieve the opposite by occluding the background if it is too bright, resulting in a dark face.

#### 7.1.3 Color offset

It turns out that the sensors tend to produce misaligned data (see table 7.1). If you are using the OpenNI2 driver, you can adjust this using the corresponding settings. Please note that this has a significant impact on the training as well; if you change this setting, you should scan your expressions again and build a new profile.

Table 7.1: Color offset adjustment:



#### 7.1.4 Sensor positioning

The tracking works best if the actor is facing the camera. Since the chin is often a reliable reference, best results are achieved when the sensor is positioned slightly below the level of the face.

## 7.2 Achieve the Best Tracking Results

#### 7.2.1 Setup

Make sure that your camera is set up correctly. Check out the tips to set up your camera (see section 7.1). In particular:

- Lighting: Uniform, diffuse lighting without strong highlights works best. Make sure that no part of the image is saturated.
- Distance: The actor should be at about 60 cm distance and facing the sensor, best results are achieved when the sensor is positioned slightly below the height of the face. But make sure not to get too close to the sensor, holes in the depth data are often the result.

#### 7.2.2 Training

It is strongly recommended to use the same sensor for training and tracking, because the calibration often changes slightly between them. The same is also true for the OpenNI 2 HighRes and Video Offset settings in setup mode: Use the same parameters for tracking as for training.

#### 7.2.3 Tracking

Occlusions: Actors with long hair should use a head band to keep the hair back. Since the forehead is a relevant cue for tracking, a bonnet can help to keep it clear even for shorter hair. When the lighting is good, move the slider Geometry - Texture in the Track panel more towards Texture to get a more responsive result with less jitter.

#### 7.2.4 Post Processing

Refining the track produces a significantly more accurate and smooth output. It works best if you manually mark up the features on some frames.



## 8. FAQ

### 1. Activating behind a proxy server

If you get the message "Unable to connect to http://www.faceshift.com to download the license. Please make sure that this system is able to access the internet and try again.", then you might be behind a proxy server. In that case try the following:

Set the environment variable `HTTP_PROXY` to `HOST:PORT`, where `HOST` is the proxy name and `PORT` the proxy's port.

If your proxy server uses authentication, you use the `HTTP_PROXY_CREDENTIALS` environment variable to pass the credentials to the proxy server: `HTTP_PROXY_CREDENTIALS` - the username and password to authenticate you to the proxy server, in the format `user:password`. For example, if your username is "joe" and password is "joes\_password": set `HTTP_PROXY_CREDENTIALS joe:joes_password`

### 2. Which cameras are supported by faceshift?

See the supported sensors table [1.1](#).

### 3. Do I need a depth camera?

Yes. The tracking in faceshift studio relies heavily on depth data, therefore such a camera is indispensable.

You will have to get an Asus Xtion Pro Live, Microsoft Kinect for Windows, or Microsoft Kinect for Xbox 360. The price range of such a camera is currently about \$150-\$200.

We also bundle a camera with faceshift studio for an additional \$300.

#### 4. Alert: "no drivers installed"

This happens when faceshift cannot find your camera, or you installed the wrong drivers.  
If you own a...

- PrimeSense Carmine 1.09 or Asus Xtion Pro Live => Install the OpenNI drivers
- Asus Xtion Pro => This camera has no color sensor, a Pro Live camera is needed
- Microsoft Kinect for Windows => Install the Microsoft Kinect SDK
- Microsoft Kinect for XBox360 => Install the Microsoft Kinect SDK or OpenNI with the unofficial SensorKinect drivers

For further details, see section [1.2](#).

#### 5. What kind of data can I get out of faceshift?

##### Tracking

Faceshift analyzes the facial expressions of the actor, and calculates:

- **head pose** (position and rotation of the head)
- **gaze direction** (how the eyes are rotated)
- **blendshape activations** (weights between 0 and 1 that describe how strongly each of a large number of basis expressions, eye shapes and mouth shapes is activated)
- **marker positions** (the 3D location of arbitrarily chosen virtual markers on the face)

Additionally, we also save the video and audio for use as witness data. You can export this data in a number of different formats, from virtual marker sequences to complete animations in fbx format (see chapter [6](#)).

Apart from using faceshift to drive animations, you can also use it to do reliable and repeatable measurements on faces. The automatic avatar building parametrizes all faces in the same way, such that it is easy to measure distances and angles in neutral and expressive state by exporting virtual markers and making these calculations on the virtual markers.

This data can be exported live during tracking or offline after refining the sequence inside faceshift for even higher accuracy.

##### Training

During training we build a custom avatar of the actor. This avatar can be exported and used in your animations.

#### 6. 3D Sensor Freeze

Sometimes the 3D sensor (Asus Xtion Pro Live or PrimeSense Carmine 1.09) may freeze.

To fix this issue please check the following

- If using OpenNI 2.0 please uncheck FrameSync in the Setup view and see if the sensor provides data again. Sometimes the FrameSync settings results in the camera freezing. However, we do recommend to have FrameSync enabled.
- We have reports that when Audio Input is set to the camera sensor the camera framerate drops significantly or may even freeze. We recommend not to use the 3D sensor as Audio Input.



## 9. Known Issues

### 1. Faceshift studio 1.3 (or earlier) crashes on startup if 2014.1 is installed

In faceshift studio 2014.1, the format of some files that are loaded on startup was changed. Earlier versions do not support these formats and crash when they attempt to load them. This affects actor profiles (\*.fsu) and template rigs (\*.fsrig). It is still possible to launch the earlier versions by deleting or renaming the "faceshift.ini" file located in the faceshift studio workspace.

### 2. PrimeSense device for audio input

The PrimeSense Carmine 1.09 and Asus Xtion PRO LIVE devices come with integrated microphones. In some cases this audio input can significantly slow down the color/depth image input from the camera, or even crash faceshift studio when you switch to Tracking mode. To avoid this problem, go to "Preferences", select the "Audio" section, and set "input device" to "None" or some unrelated audio source. Please note that the "default" device can also be an alias for the camera's microphones. On Windows 7/8, you can permanently disable that as follows: right-click the Speakers icon in the system tray, choose "Recording devices", right-click the camera device and select "Disable".

### 3. Android File Transfer blocks camera (Mac OS X only)

There are cases where the camera stopped working after installing Android File Transfer. In particular, the Android File Transfer Agent running in the background seems to prevent the camera from working. To stop it, run Activity Monitor and kill any running instances of Android File Transfer Agent. You might also want to [disable Android File Transfer Agent permanently](#).



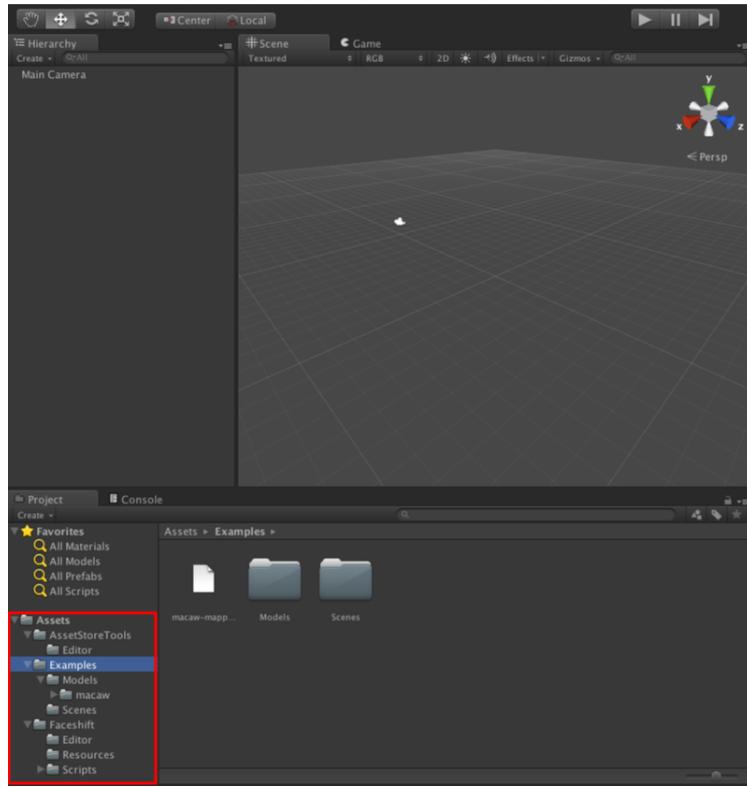


## 10. Unity Plugin

Create stunning animations with motion capture at your desk. Faceshift is a markerless mocap system which uses a depth camera to capture an actors expressions. It tracks with a FACS-based model, essentially estimating muscle activations of the actor. The faceshift for Unity plugin takes clips analyzed by faceshift, and allows you to map them onto arbitrary blendshape-based rigs. The package contains example scenes and tutorials to get you started, and you can use the faceshift studio trial to generate your own motion capture sequences.

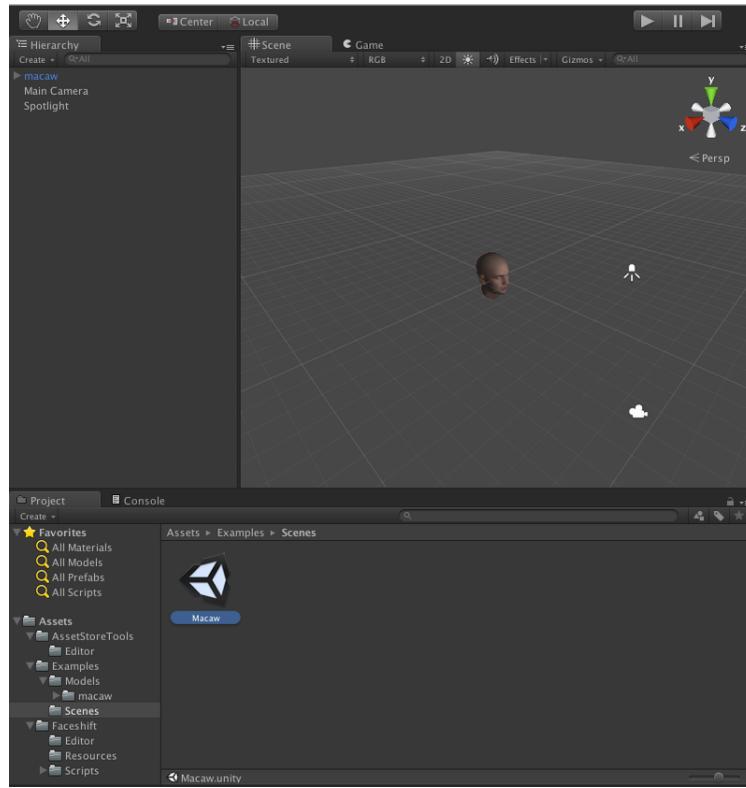
### 10.1 Installation

The faceshift plugin is located in the Unity Asset Store under the category "Editor Extension > Animation". Download and import the plugin from the Asset store. The package content should be displayed in the bottom left panel with the other assets.



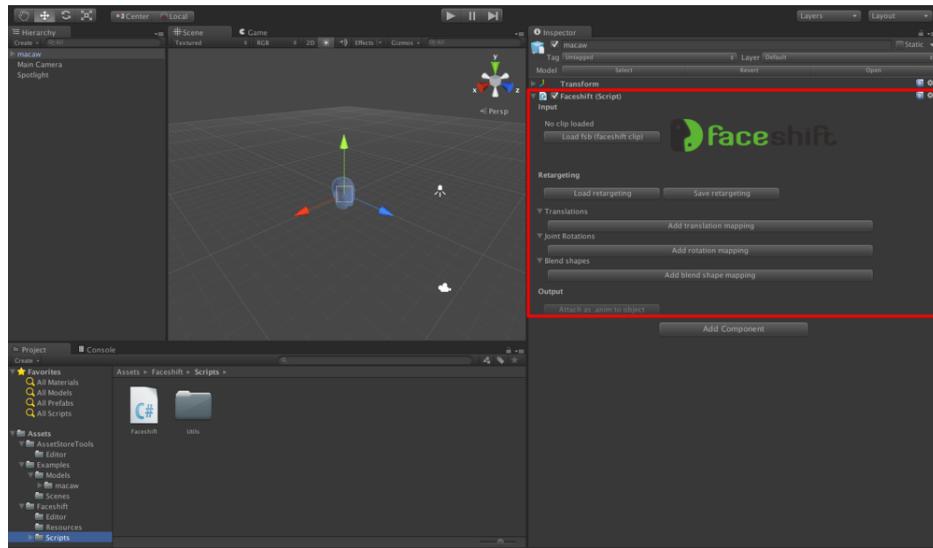
## 10.2 Setting up the Scene

The Faceshift plugin provides an example scene containing a model, a spotlight and a camera. Load the example scene by double-clicking the "Macaw" icon in "Examples > Scenes". You should see the Macaw character in the scene as well as the spotlight and the camera objects.



### 10.3 Get the GUI

Select the Macaw model in the Hierarchy panel on the left of the interface. From here, go in "Faceshift > Scripts" and drag the "Faceshift" script onto the Inspector panel on the right to add the Faceshift component. The Faceshift user interface is now loaded and you can start using it.



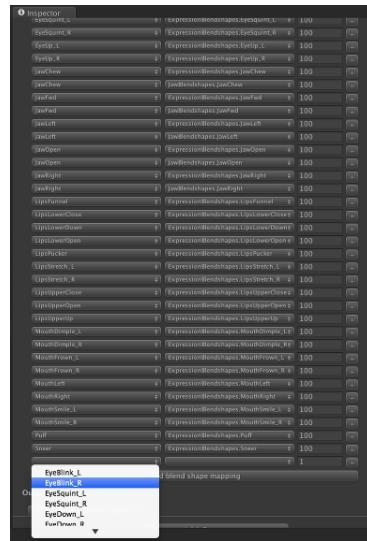
### 10.4 Loading the Clip

For this step it is assumed that you already created a Faceshift clip using Faceshift Studio. Should this step be something new to you, please refer to our Tutorials page and learn how to create and

export a Faceshift animation. The "Examples" folder contains a sample clip file that you can use for testing. Click on the "Load fsb (faceshift clip)" button and select the clip you want to load.

## 10.5 Retargeting

The retargeting step permits you to do the mapping between the Faceshift animation and your Unity character. For doing so, you have the possibility to map blendshapes as well as translation and rotation joints. Use the corresponding "Add translation mapping", "Add rotation mapping", "Add blend shape mapping" buttons to define all the mappings that you need. The "Examples" folder contains a sample retargeting file ("macaw-retargeting.fst") that you can directly load using the "Load retargeting" button to see how it is done for this macaw model. You can play with the coefficients to change the relation between corresponding blendshapes and see how it would alter the animation output.

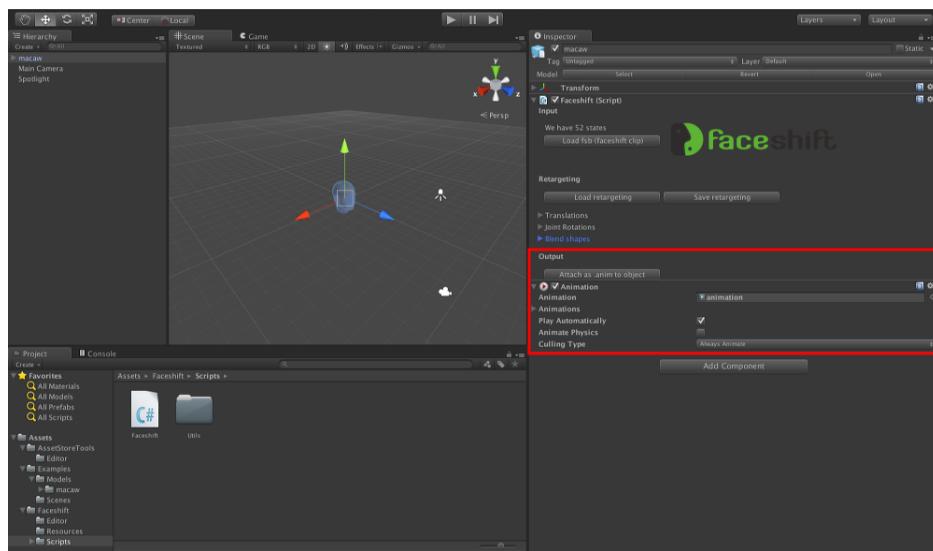


## 10.6 Animation

As soon as you completed the retargeting part, you are ready to animate your character. Select the "Attach as .anim to object" button and give a name to your new animation file. The file will be stored as an ".anim" file in your Assets directory.

**Important:** to make sure this works correctly if you use your own scene, do the following in Unity3D:

1. In the "project" window in the Assets hierarchy, click on your fbx model
  2. In the inspector, you should see now the Import Settings of your model
  3. Select in these Import Settings in the "Rig" tab for the "Animation Type" the value "Legacy"

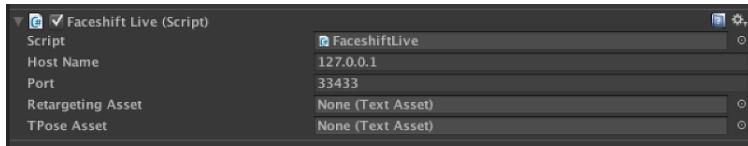


You can now hit the "play" button to enter the Game mode of Unity and see your character being animated.

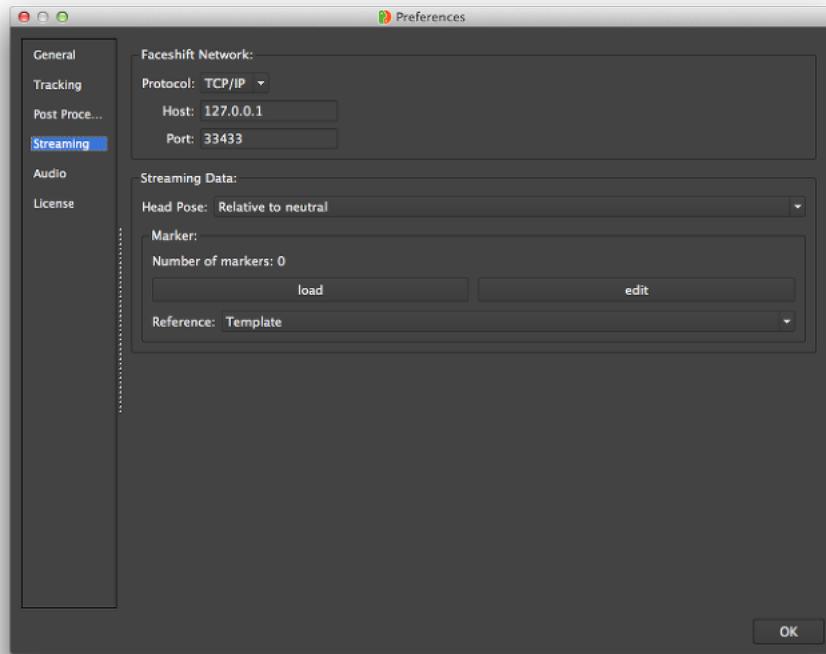


## 10.7 Live

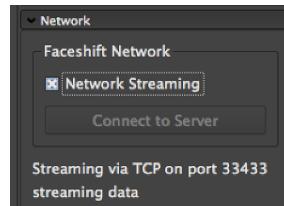
From the version 2.0 you will be to interact from faceshift studio to unity in live mode. A new live panel appears when you load the faceshift unity plugin:



It requires the Retargeting and TPose files to do the mapping between the faceshift animation and the unity character (see section "Retargeting"). The host name and the port information should correspond to the values set in faceshift studio, under "Preferences > Streaming".



In the Tracking module of faceshift studio, make sure to enable the Network streaming.



You are now ready to animate your unity character live using the faceshift live tracking module.

## 10.8 Videos Tutorials

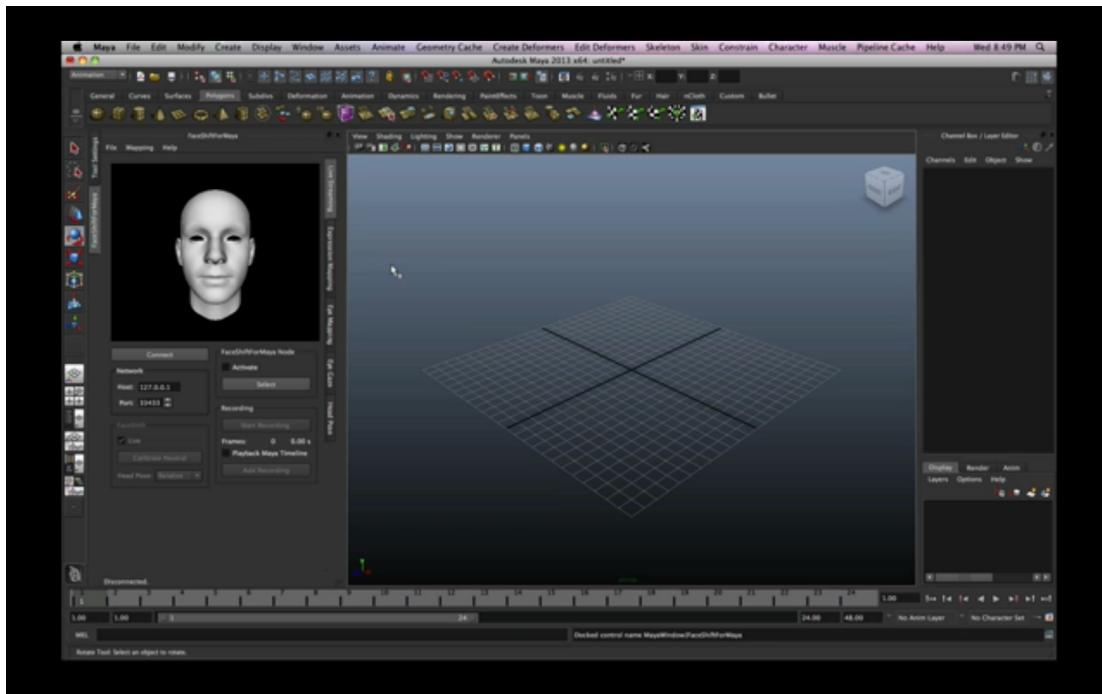
Part 1: Create animations

Part 2: Live





## 11. Maya Plugin



### 11.1 Installation

The faceshift for Maya plugin now supports Maya 2014, and you can download it for free in the [Maya app exchange store](#).

Alternatively, you can use our own plugin installer:

[Maya Plugin \(win32/win64\)](#)

[Maya Plugin \(mac osx\)](#)

For the previous Maya versions 2011-2013, we recommend to use our own installer, as it will

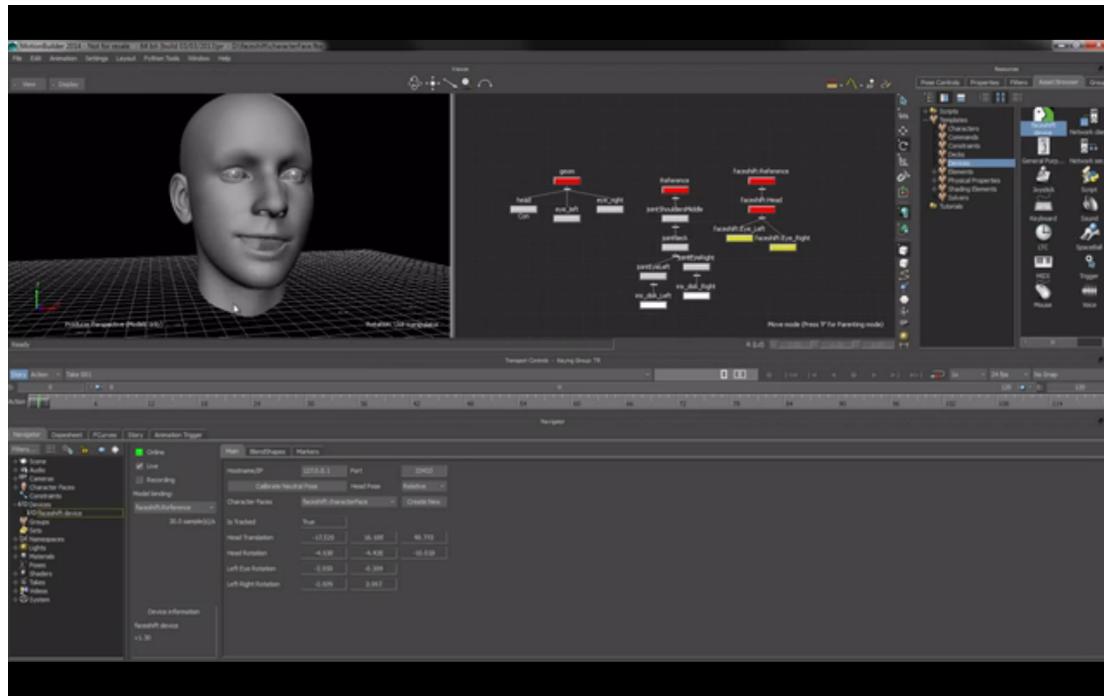
automatically install the Maya modules at the right locations so that Maya will automatically find the plugin.

## **11.2 Video Tutorials**

- Part 1: Starting the plugin
- Part 2: Connecting to faceshift studio
- Part 3: Recording animations
- Part 4: Tracking parameters
- Part 5: Mapping expressions (pose-based)
- Part 6: Mapping the head pose (joint-based)
- Part 7: Mapping the eye gaze (joint-based)
- Part 8: Mapping the eye gaze (pose-based)



## 12. MotionBuilder Plugin



### 12.1 Installation

The latest faceshift for MotionBuilder plugin can be downloaded from here: [Motion Builder Plugin \(win32/win64\)](#).

## 12.2 Device GUI

### Main Tab

Hostname/IP	Host of machine that runs faceshift
Port	Communications port (usually 33433)
Calibrate Neutral	Same as hitting "calibrate neutral" button in faceshift interface
HeadPose	Stream head pose as relative or absolute coordinates
Character Faces	Displays all "Character Face" nodes in scene <ul style="list-style-type: none"> <li>• selected one will be driven with faceshift blendshape data</li> <li>• note that only compatible channel names will be driven (lookup is by name)</li> </ul>
Create New	Creates a new Character Face using the available blendshape names from the faceshift stream. This is ready for the user to connect blendshapes/transforms to and set poses
IsTracked	(readOnly) Indicates if face is found by faceshift tracker
Head Translation	(readOnly) Position of head
Head Rotation	(readOnly) Rotation of head as euler angles
Left_eye rotation	(readOnly) Left eye rotation
Right_eye rotation	(readOnly) Right eye rotation
Model Binding	Creates a hierarchy in the scene containing: <ul style="list-style-type: none"> <li>• Reference node: can be used to transform the whole hierarchy in the scene</li> <li>• Head node: contains position/rotation and can be used as a source for rigging also contains all the blendshape channels as custom channels</li> <li>• Eye Left node: contains left eye rotation and can be used as a source for rigging</li> <li>• Eye Right node: contains right eye rotation and can be used as a source for rigging</li> <li>• Marker nodes: contain positions and can be used as a source for rigging</li> </ul>

### BlendShapes Tab

Displays read only list of blendshape names and values from faceshift.

### Markers Tab

Displays read only list of markers with their names and x,y,z position values from faceshift. It can be empty if faceshift is not streaming markers.

## 12.3 Rigging

### Rigging directly

The head and eye nodes created with Model Binding in the device can be used to drive elements in the scene. For example by using position/rotation constraints to make other objects follow. Or (as done in the example scene) using a relation constraint to make more elaborate connections.

### Rigging using character face

The device can create a character face node containing all the blendshapes. A user can drop in a model with blendshapes (as done in example scene) and for each faceshift blendshape set a combination of blendshape percentages on the model. Multiple models can be connected in the same character face node. You can also drop any transform (bone, mesh etc) into the character face, set poses on those and connect those to the faceshift blendshape channels in the faceshift. This is all standard functionality of MotionBuilder and is best learnt by spending some time with the Autodesk documentation and tutorials.

## 12.4 Example Scene

The MotionBuilder example scene can be found in the installation directory of the MotionBuilder plugin (subdirectory of the faceshift installation). Note that the example scene is compatible with the v2 tracking rig.

## 12.5 Video Tutorials

[Part 1: Intro](#)

[Part 2: Data](#)

[Part 3: Using Markers](#)

[Part 4: Rigging Head and Eyes](#)

[Part 5: Rigging Character Face](#)

[Part 6: Record Plot](#)