



MARK ROBERTS MOTION CONTROL

POLYMOTION CHAT STUDIO 3.0



QUICK START GUIDE

Product code: MRMC-1999-15

Polymotion Chat Studio 3.0 Quick Start Guide

Product code: MRMC-1999-15

© 2022 Mark Roberts Motion Control Ltd. All rights reserved.

No part of this publication may be reproduced, transmitted, or translated by any means — graphical, electronic, or mechanical — including photocopying, recording, taping, or storage in an information retrieval system, without the express written permission of Mark Roberts Motion Control.

Although every care has been taken to ensure that the information in this document is accurate and up to date, Mark Roberts Motion Control continuously strives to improve their products and may make changes to the hardware, firmware, and software described in this document. Mark Roberts Motion Control therefore cannot be held responsible for any error or omission in this document.

All product names mentioned herein are the trademarks or registered trademarks of their respective owners.

Contact information	
Mark Roberts Motion Control Ltd.	
Unit 3, South East Studios	
Blindley Heath	
Surrey	
RH7 6JP	
United Kingdom	
Telephone:	+44 (0) 1342 838000
E-mail:	info@mrmoco.com (sales and general enquiries) support@mrmoco.com (customer support)
Web:	www.mrmoco.com www.mrmocorentals.com

Contents

Chapter 1	Polymotion Chat Studio 3.0	1
	Overview of Polymotion Chat Tracking System	1
	Setting up Polymotion Chat Studio	1
	Connecting Cables (Dell 1U Server).....	2
	Connecting Cables (Dell 2U Server).....	3
	Launching Polymotion Chat	4
	Setting up Polymotion Chat using Network Setup and Chat wizard	4
	Setting up the robotic heads for Polymotion Chat	12
	Polymotion Chat Main page.....	13
	Axes sliders and joystick controls.....	14
	Tracking Sensitivity	15
	Setting pan and tilt soft limits	16
	Presets.....	17
	Preset Banks	17
	Storing a non-tracking preset.....	18
	Storing a tracking preset	18
	Configuring a Preset.....	20
	Autoframing	21
	Person to look for (Face Recognition).....	23
	Liveview graphics settings.....	24
	Starting Tracking	25
	Altering Static Zones.....	28
	Switching Face Recognition to Another Person.....	29
	Fine adjustment of autoframing zoom position	29
	Motion Prediction	29
	Stopping Tracking.....	30
	Face Capture Page	30
	Multi-screen View.....	34
	Moves Page.....	35
	Selecting a head.....	35
	Presets.....	36
	Storing a position as a preset	36
	Activating a preset.....	37
	Editing a preset button.....	38
	Moves	38
	Activating a move.....	39

	Stop button	40
	Changing Tracking Settings in the Client View	40
	Polymotion Tab Settings	44
	Depth Sensing	44
	Aligning the Depth Sensing Heat Map	47
	Polymotion Chat API	49
Chapter 2	Using Rail	51
	Rail Setup	51
	Configuring Rail	53
	Using the Rail	54
	Notes Regarding Rail Setup	55
Appendix 1	Polymotion Chat Installation and Backup	57
	System requirements for Polymotion Chat Studio	57
	Installing Polymotion Chat	57
	Configuring the Polymotion System	59
	Configuring the Blackmagic DeckLink cards	59
	Installing Polymotion Launcher	59
	Installing CV Engine	65
	Licensing your Polymotion Product	68
	WRNCH Licensing	69
	Backup and Restore CV Engine Settings	70
	Import	70
	Export	71
	Save Config	71
	Restore Defaults	72
	Remote Client Configuration	73
Appendix 2	Troubleshooting	75
	Resolving Video Feed issues	75
	Handling Lost Video Feed Issue	75
	Graphic Card Device Driver Issues	77
	Typical symptoms, causes, and actions	78

Chapter 1 Polymotion Chat Studio 3.0

Overview of Polymotion Chat Tracking System

Polymotion Chat is an advanced broadcast camera automation system solution. The advanced integrated AI engine detects face and limbs building a model of the subject and uses this to control and predict movement delivering high quality and natural camera motion. The easy to use interface allows the operator to create presets, define static zones (so the camera will only move when there is enough movement by the subject), create an offset to allow for graphics to be on screen with the talent, manage acceleration and deceleration so the movement remains natural even on very tight or wide shots and many other options.

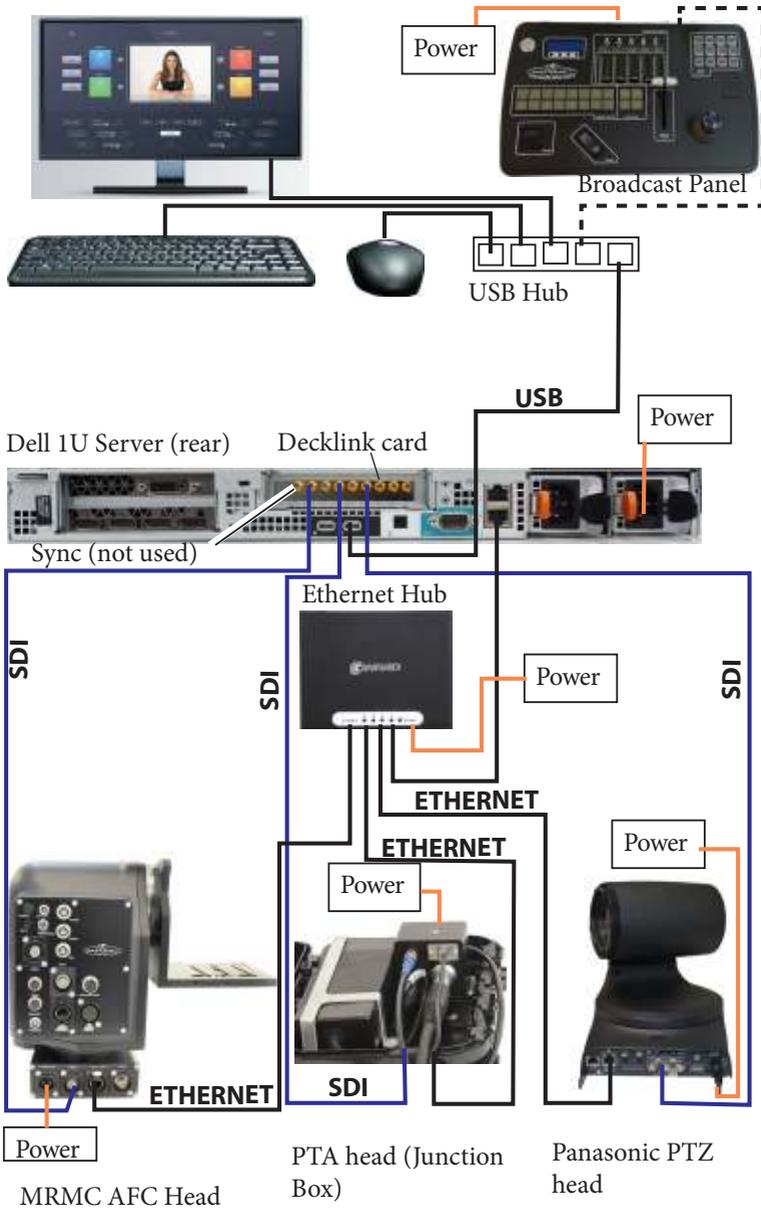
Setting up Polymotion Chat Studio

Polymotion Chat Studio can be set up on the following types of servers:

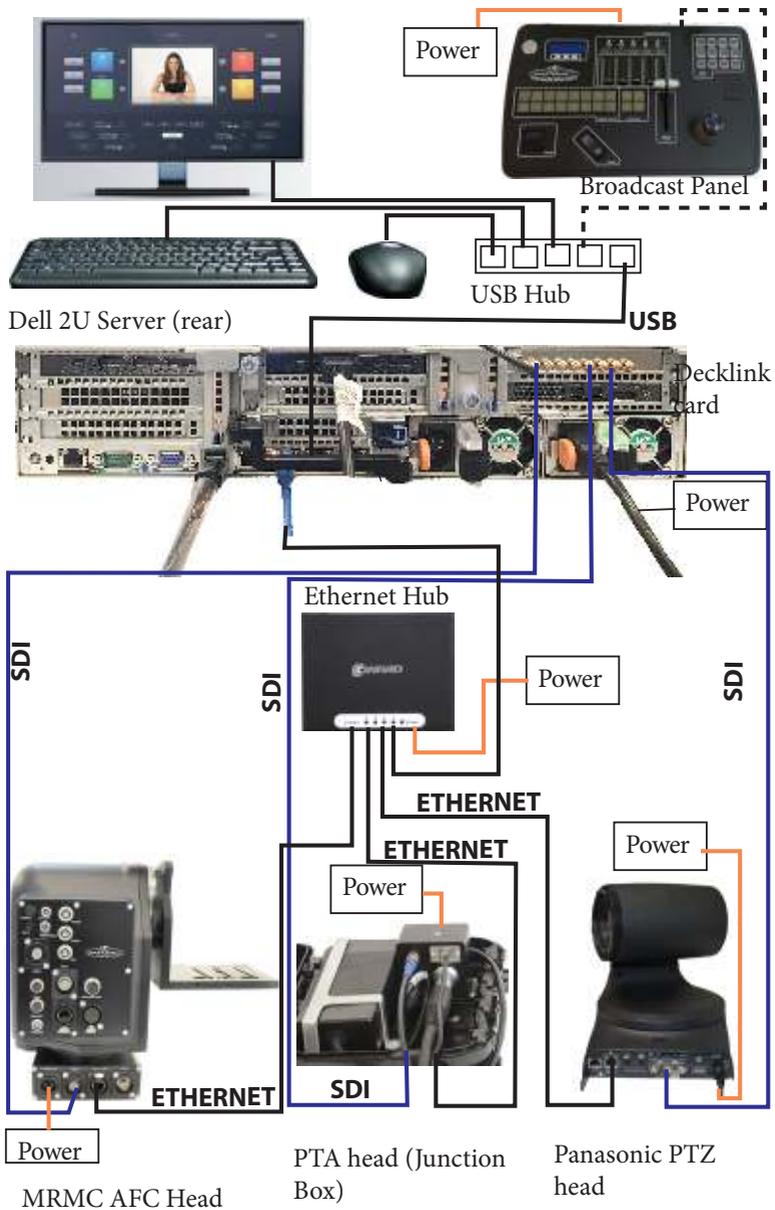
- Dell 1U Server: Supports up to three channels or 3 robotic heads
- Dell 2U Server: Supports up to 6 channels or 6 robotic heads.

Cable connections and the type of heads supported for both servers are similar, except that the Dell 2U server can support up to 6 heads. (For more information on system requirements, refer to *System requirements for Polymotion Chat Studio* on page 57.)

Connecting Cables (Dell 1U Server)



Connecting Cables (Dell 2U Server)



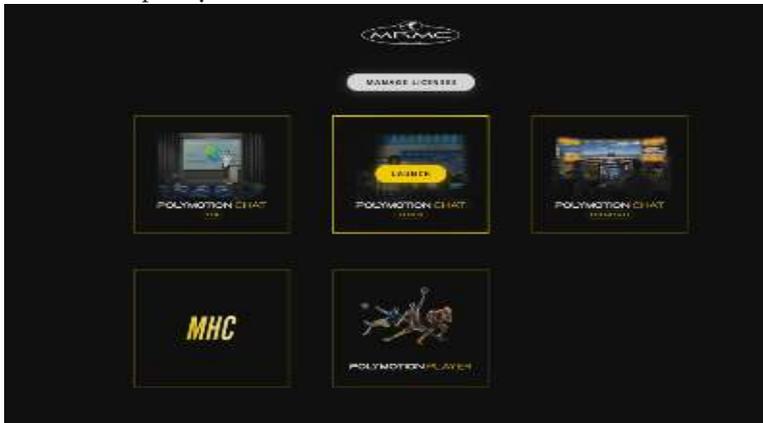
Launching Polymotion Chat

MHC Polymotion Chat runs via a utility called Polymotion Launcher. To learn more about installing Polymotion Launcher, refer to Appendix 1 *Polymotion Chat Installation and Backup* on page 57.

1. Use the icon on desktop to launch Polymotion Launcher.



2. Click/tap **Polymotion CHAT Studio/Broadcast.**



3. If you are launching this for the first time, you will be required to add a new license file or a license code. Contact MRMC Support for a new license. Refer to *Licensing your Polymotion Product* on page 68.
4. Once you have supplied a license code, MHC Server and Client are launched, login to MHC Client as Admin:
Username: Admin
Password: Admin1234

Setting up Polymotion Chat using Network Setup and Chat wizard

1. Cable together the robotic heads, Polymotion PC, cameras, and joysticks participating in the Polymotion network. Also connect the PC with the cameras using appropriate cables and data converters depending on method used for streaming the video. The possible

incoming sources of videos used by Polymotion system are: **USB Device, RTSP Stream, Decklink** and **NDI**.

2. Use the **FIND** button to retrieve a list of available robots on your network. Add all the robots that would be part of the Polymotion Chat system in the MHC Network setup page. Remember to specify the robot type for each of the participating robotic head



You can assign heads to a specific user, multiple users or all users.

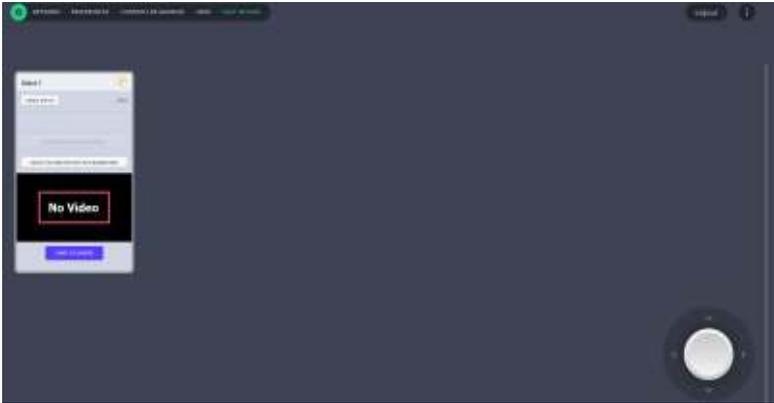
Note

If a selected robot does not go green, then check it is on the same IP address range as the server PC. The Find button does a network wide broadcast, therefore it finds heads even on different subnets.

Note

If an NDI protocol robot, such as that with a rig type of NDI_PTZ, is not being detected in Network setup page (turning green), then it is recommended that you download and install NDI Studio Monitor tool from NDI website. If the NDI Studio Monitor cannot detect the NDI protocol robot, then the Chat system will not detect it (as the Chat system uses the same source library as the NDI Studio Monitor for source detection).

3. Select Settings  > **CHAT WIZARD**. This page shows the added robots as boxes where video feed from each of them can be set up.



4. Under **VIDEO INPUT**, select the source of the video feed.



5. Select the **DEVICE**. If the selected video input is **Decklink** or **USB device**, then **DEVICE** is the port receiving the video feed from the camera on the robot. If the selected source is **RTSP** or **NDI stream**, then add the stream address in the appearing box.

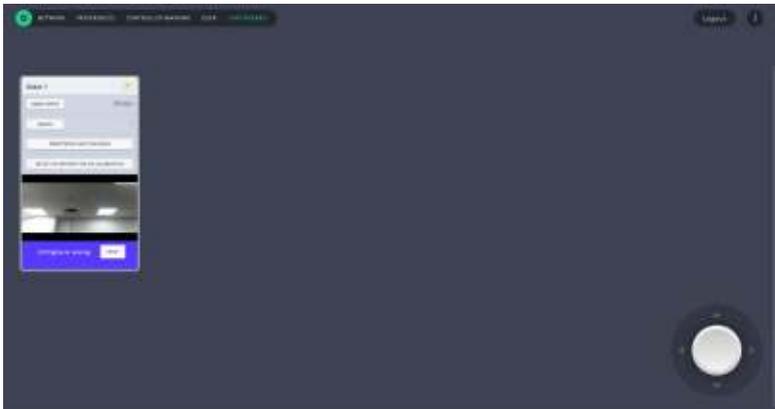


You can add up to 10 USB devices and 16 Decklink channels.

Tip

Use the on-screen joystick (pan-tilt) control to move the robot slightly to easily identify the robot if you are not able to do so by the name of the robot.

6. Click **Start CV Engine** to start the program that enables Polymotion tracking in MHC. As you do so, notice that additional windows pop up, which can take up to 30 minutes; these windows are for MRMC CV Engine, a software application that runs in the background to enable Polymotion Chat, and must not be closed at any instance while using the system for accurate functioning.



NDI video feed issues

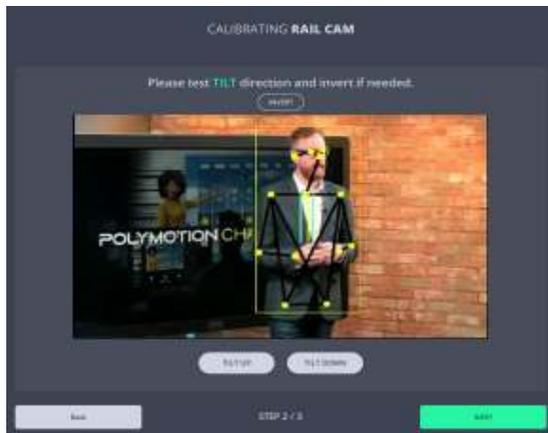
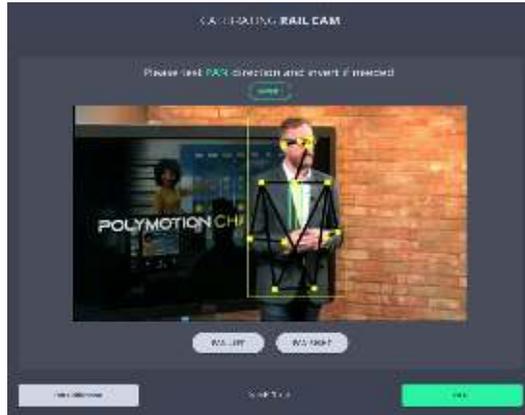
- If a video input was selected as NDI in Step 4 but is not displayed after clicking Start CV Engine, then it is recommended that you download and install NDI Studio Monitor tool from the NDI website. If the NDI Studio Monitor cannot detect the NDI video, then Chat system will not be able to detect it (as the Chat system uses the same source library as the NDI Studio Monitor for video source detection).
- On some servers or PCs, one of the two NDI heads or streams may not work if both NDI heads are connected to two different network ports of that server or PC. This issue can be resolved by connecting both NDI heads to a hub and then the hub to one of the network ports.

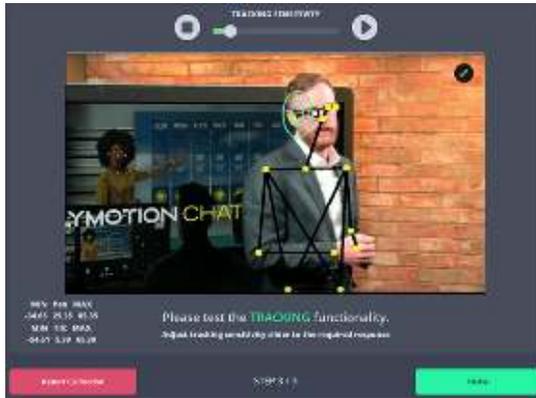
Note

After Polymotion Launcher installation, when CV Engine is started for the first time, a configuration process for graphics cards, called PoseNet Initialisation, is started which can take up to 30 minutes for a Dell 2U server and up to 20 minutes for a Dell 1U server. For each subsequent Polymotion Chat launch, this process will take only a few seconds. During PoseNet Initialisation, the video feed appears with a message **CVE PoseNet Initializaing**. After clicking 'Start CV Engine' for all participating heads, users are advised to wait for this message to disappear before using tracking functions in the Chat system.

7. Click **Directions and Tracking** to calibrate Pan and Tilt axes. The pan and tilt axes direction should be set accurately for accurate tracking. For this, use the on-screen joystick control to check

whether the robotic heads are moving in the direction of the joystick.

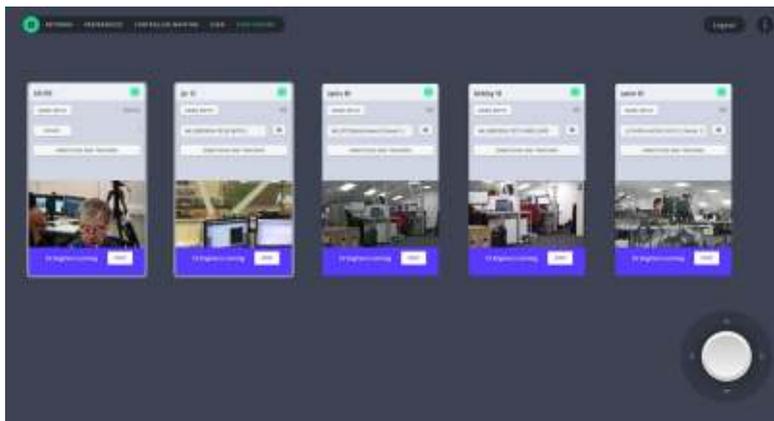




Click the **Home** button to home all axes; use the **Fix** button to fix any tripped axes, if required.

In this step, you can adjust the **tracking sensitivity** by clicking the play button to temporarily start tracking and then tweaking the sensitivity using the slider. To modify tracking sensitivity a person needs to be present in the frame to allow tracking to begin. If that is not possible, skip this step.

8. Repeat Steps 2-7 for all the robotic heads that are part of Polymotion Chat system.



These are instructions when both MHC Server and Client are on the same machine. To configure MHC Client on a remote PC, follow the instructions in *Remote Client Configuration* on page 73.

Note

Log in as an Engineering type user. Use Settings  > **User** page to check whether one is already set up or create a new one.

Setting up the robotic heads for Polymotion Chat

Provided all the participating robots are connected properly and video feeds from all the cameras are being successfully received and are correctly configured, your first session will involve logging in to the MHC Client.

Note

You can use the default 'Operator', 'Engineer' or 'Supervisor' account to log in to the MHC (Chat) Client display. Operator account allows access to all screens/settings except the Robot Settings page which includes the Polymotion and CV Engine tabs (refer to *Changing Tracking Settings in the Client View* on page 40). The default passwords are:

Username: **Operator**

Password: **password**

User name: **Engineer**

Password: **password**

User name: **Supervisor**

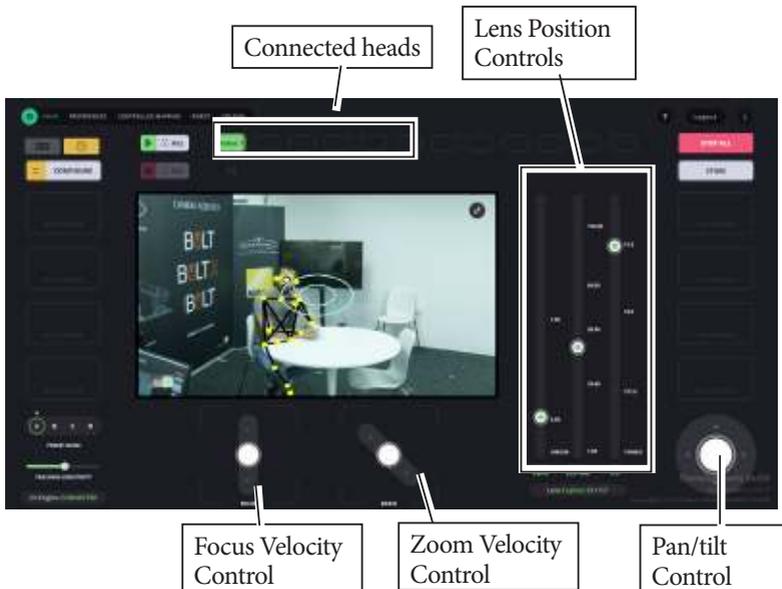
Password: **password**



When you login to MHC Client, this multi-view screen view appears which shows the live feed from all the connected cameras. If you have only one camera, then it goes straight to the operator screen. You can select the live feed from any camera to set up presets, begin tracking and change the tracking settings for that camera.

For more detail on Multi-screen view, go to *Multi-screen View* on page 34.

Polymotion Chat Main page



The controls on the Main page can be used to move robotic head axes and set up and run presets which can be later used to follow targets

automatically. Also, Engineer -type users have additional controls like the Configure button, which Operator type users do not.

Note

When Chat Main page is started for the first time after Chat installation, the CVE PoseNet Initialization process is started and a message appears in the LiveView window. This process will continue for up to 30 minutes depending on the number of heads in your Chat configuration. For each subsequent launches this will take only a few seconds. While this process is in progress, the tracking controls will not function in the Chat program.



Axes sliders and joystick controls

The Focus and Zoom Velocity sliders can be used to moved the lens axes in either direction. They are velocity controls in that the further they are pushed the faster the axes move.

The Pan /tilt joystick control is a directional control for Pan and Tilt axes.

The Focus, Zoom and Iris sliders on the right are position controls in that they can be used to move the lens axes to specific positions shown by the markings as stored in the lens table for the lens physically installed on the robotic head. It is important that the lens table is set up properly in **Robot>Lens tab** for these to function accurately.

Important

End stops on Focus and Zoom are not supported for Panasonic PTZ devices.

In order to get the pan and tilt end stops to work smoothly for Panasonic PTZ heads, Chat system uses the settings in the head. The applicable models incorporate an EEPROM for storing the settings, and each time a command that changes the settings is received, data is written in the EEPROM. The number of times data can be written in the EEPROM is limited so if data is sent frequently, the model will cease to operate normally when the maximum number of times for writing the data has been reached. Therefore, it is recommended that end stops are not changed frequently for PTZ heads to prevent EEPROM from failing.

Note regarding Panasonic PTZ Head Zoom function

On the Panasonic PTZ head, if you are on a wide zoom setting, the head can focus quite closely, such as 0.5m. However when you zoom in to the telephoto end of the zoom, the closest the head focus is about 3m. The software in the Panasonic knows about this and will move the focus slider up when you zoom in.

Also if you are at the tight end of the zoom and try to move focus to a close position, the software in the head will not allow you to do this. It will move to the closest possible focusing distance.

Tracking Sensitivity

Tracking sensitivity determines how quickly the camera moves in reaction to the target moving away from the reference point, i.e. the deflection from the desired position. This feature gives better control over lower speeds. For example, when the slider is at the half way mark the sensitivity demand is only 20%. Use a high tracking sensitivity value for generally wide on zoom.

Tracking sensitivity automatically adjusts based on the lens FOV or zoom level. The more zoomed in the lens is, the less the camera is panned and vice versa. You should have the lens table set up for this to function accurately.

Setting pan and tilt soft limits

If the subject moved to an undesirable position, having set the soft limits will prevent the robotic head from moving further in that direction. Carefully set the soft limits for pan and tilt axes to prevent the robotic heads from moving to positions outside the desired area.



To set soft limits:

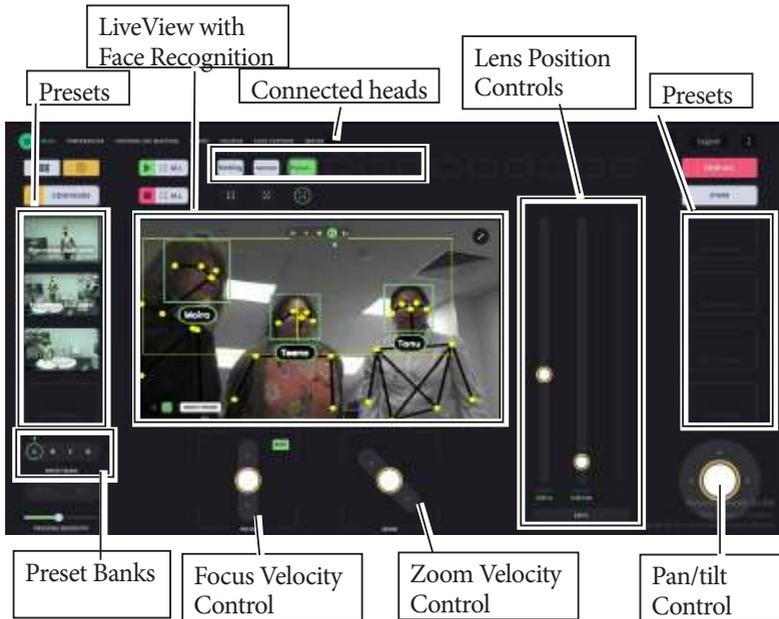
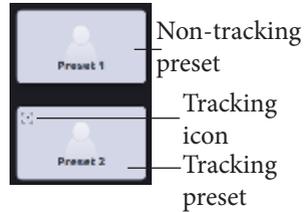
1. Use the joystick to position an axis at a point that you want to set as minimum limit.
2. Click the first SET button to set the minimum limit.
3. Similarly, position the axis at the point you want to set as maximum limits.
4. Click the second SET button to set the maximum limit.
5. Use steps 1-4 to set soft limits for the required axes in the all the participating robotic heads. Use the arrows shown in the above picture to navigate between the robotic heads.

Note regarding Panasonic head's preference limits

All preference limits are cleared when Panasonic head is removed from MHC or added to MHC. Therefore, the user needs to re-set them when adding the head in MHC.

Presets

The Polymotion Chat Operator page allows for 32 positional presets organised in 4 banks of 8 presets each. Each of these presets can be set as tracking or non-tracking. For each camera, **Tracking presets** are used for setting the starting position for limb detection and tracking and **non-tracking presets** used to store a position. When storing a position, all the axes positions are stored. A preset button is faded when no position is stored in them.



Preset Banks

On the Chat main page, presets are organised in 4 banks in groups of 8 presets for each bank allowing you to store and use upto 32 presets. Click on the bank to switch to 8 presets for that bank. A green dot appears over the bank when you activate a preset for a bank and remains on the bank with last activated preset even when you move between different banks.

Storing a non-tracking preset

1. Click/tap one of the connected robotic heads for which you want to store the preset.
2. Use the controls to go to the desired head position. Ensure that the Zoom and Focus axes are in correct positions. For a tracking preset, set the position of the head to the target that you want to track.
3. Switch to store mode by clicking/tapping on **STORE**. You will see that the preset buttons change to yellow, indicating that the preset buttons can be selected to store your current head position.



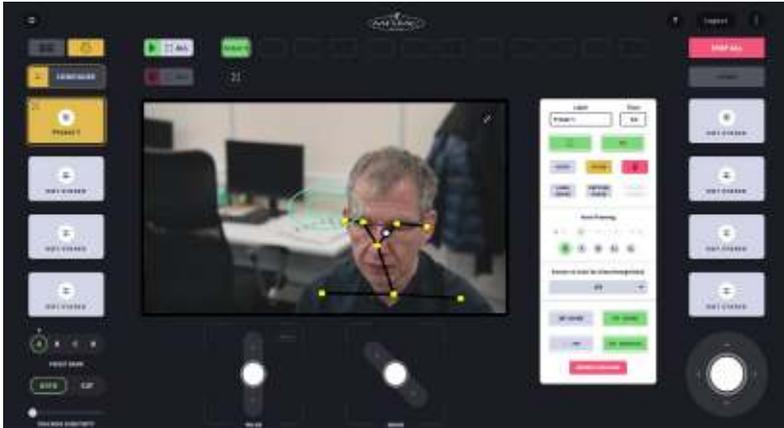
4. Click/tap on a preset button to store the current head position.

You can use these steps to **edit a preset** as well as store new preset position for a preset button.

Storing a tracking preset

1. Use the controls to go to the desired head position. Ensure that the Zoom and Focus axes are in correct positions. For a tracking preset, set the position of the robotic head to the target that you want to track.

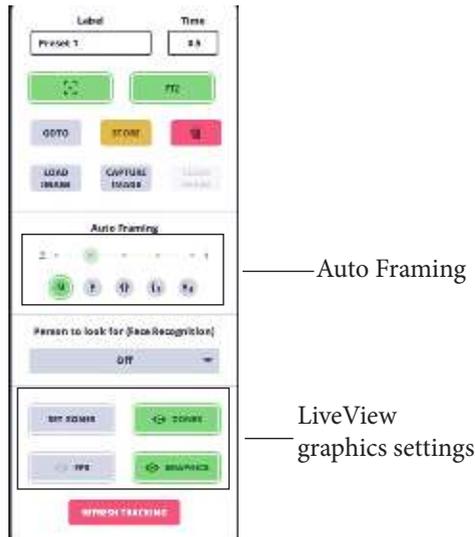
2. Switch to Configure mode by clicking/tapping on . You will see a yellow border around , indicating that the preset buttons are in the Configure mode.



3. Click/tap on a preset button that you want to set. This button will now change to yellow and a Configure box display will appear.
4. Use the section *Configuring a Preset* on page 20 to set up tracking options on a preset.
5. Clicking Store in the preset configuration stores the current preset settings.
6. Click  to exit Configure mode.

You can use these steps to edit a preset as well as store new preset position for a preset button.

Configuring a Preset



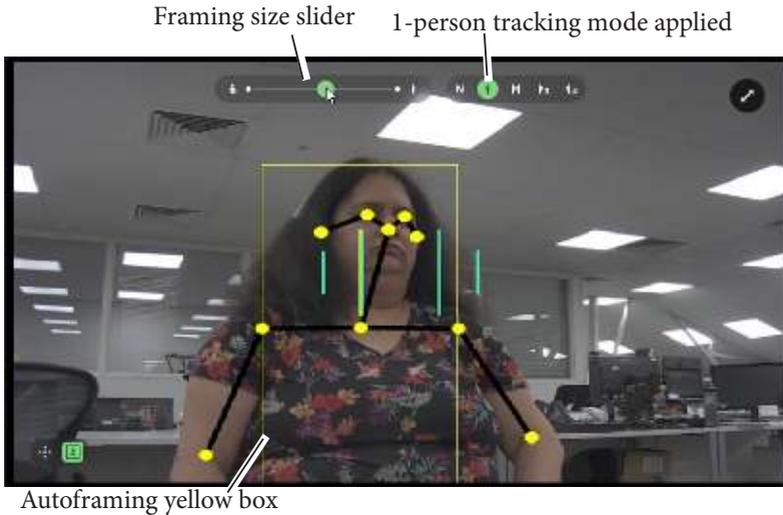
Option	Description
Label	Allows the user to set a custom name for the preset.
Time	Time taken to go to the preset if mode is set to 'CUT'. If this value is lower than the minimum time required by all axes to go to the position, then this value is disregarded and time taken is equal to that of the slowest axis.
	Sets the preset as tracking or non-tracking. Green means the preset is set as tracking preset and grey means non-tracking.

Option	Description
	<p>Toggles the preset between PTZ and non PTZ preset. When greyed, the PTZ is tracking only, in other words, when going to a preset the pan, tilt and zoom axes positions will not be changed. This option is useful if changing autoframing is desired while the head is tracking.</p>
	<p>Click to move the robotic head to the preset position stored in the preset.</p>
	<p>Stores the current position of pan, tilt, zoom, focus and iris. The tracking mode and static zone settings are stored automatically.</p>
	<p>Deletes the preset.</p>
	<p>Load an existing image for the preset button.</p>
	<p>Capture a still image from the camera and set it as the image for the preset button.</p>
	<p>Clear the image from the preset button.</p>

Autoframing

Autoframing allows you to set how much of the target(s) will be kept in the frame while tracking the target. Depending on the set autoframing mode, the Chat system works out the extent which the target will kept in the frame. In default tracking mode of 'Normal', autoframing is not applied. In all other tracking modes auto framed target is indicated by the yellow rectangle. The vertical green lines indicate the stop zone for autoframing. While tracking, you can use the positional zoom slider on the right to make fine adjustments to zoom position. In autoframing

modes, the stop zone only applies to the pan axis, tilt is handled automatically.



Tracking mode	Description
	<p>Framing size slider: Allows the user to define size of the subject’s body to be kept in frame. The slider can be used to vary the framing size from face up to full body.</p>
	<p>Normal tracking: Default framing mode where Chat system adjusts pan and tilt to keep the subject at a point in the frame. Autoframing doesn’t apply in this type of tracking.</p>
	<p>1-person tracking: In this auto framing tracking mode, the Chat system keeps one subject in the frame provided lens can zoom wide enough to capture the person.</p>

Tracking mode	Description
	<p>2-person tracking: In this auto framing tracking mode, the Chat system keeps two people in the frame.</p>
	<p>3-person tracking: In this auto framing tracking mode, the Chat system keeps three people in the frame by tracking the right shoulder of the person on the right and the left shoulder of the person on the left.</p>
	<p>4-person tracking: In this auto framing tracking mode, the Chat system keeps four people in the frame by tracking the right shoulder of the person on the right and the left shoulder of the person on the left.</p>

Person to look for (Face Recognition)

Face recognition is a new feature added in Polymotion Chat 3.0. This feature allows for auto tracking of a specific person based on the profile selected here. When a facial profile of a person is set up and enabled on Face Capture page, it is added in this drop-down list. This function is even available when tracking multi subjects. For example, when a preset is set to 1-person tracking and that person’s profile name is selected in the ‘People to look for’ list, when the preset is activated, the head will auto-track the specified person and display their profile name in the boxes in the Live View video. To learn more about how to set up Face Recognition, see *Face Capture Page* on page 30. Face recognition allow for the following 3 states:

Off: No face recognition is performed and when the preset is selected, a nearest target is picked. If they move out of the frame and another subject enters the frame within a specified time, then the Chat system tracks them otherwise tracking stops.

Any: When the preset is activated, the prime subject is the first recognised person found closest to the static zone. If that person leaves the frame, another recognised person is picked for tracking until the

person returns and the tracking will shift to following that person again. In this case tracking can be switched to another person temporarily by clicking on their image in LiveView video.

Specific person: When the preset is activated, tracking will begin when this person is located in the frame.



In addition, when tracking with face recognition on, a toggle button of 'Deselect Person' appears in the Liveview Video allowing the user to select another person for face recognition. To use this option, stop tracking, deselect the person, move the camera so the static zone is near to the new person you want to track, then start tracking again.

When using face recognition, it is recommended that all the people in view of the camera have a profile in the face database and those profiles are all enabled. If a person appears in the video and they do not have a profile, or their profile is disabled, then there is a chance they will be recognised as the wrong person. In other words, there could be a false positive recognition.

Liveview graphics settings

Option	Description
	Toggles showing the detection points in the LiveView.
	Show the FPS, or how fast the system is doing tracking; green indicating on and grey indicating off. (This is different from the camera's speed in FPS and can be slower.)

Option	Description
	<p>Enabling this button allows you to change the heights and widths of the static zone (green boxes or ellipses). The minimum width and height is that of the inner zone and the maximum width and height is that of the outer zone. The camera moves only as much to place the white dot representing the target inside the inner zone. When the target moves but is still inside the outer zone the camera does not move. A smaller zone means target is more closely followed, resulting in more camera movement. A larger zone means less camera movement, as the target is free to move around without the tracking reacting. For more information on changing the static zones, refer to <i>Altering Static Zones</i> on page 28.</p>
	<p>Toggles showing the green boxes or ellipses for static zones.</p>
	<p>When pressed, the person closest to the middle of the static zone is picked for tracking. (Clicking the preset button also resets tracking.)</p>

Starting Tracking

Enabling tracking on a tracking preset does not automatically start tracking. There are three ways to begin tracking:

- Using the tracking presets:** To start tracking, you activate a tracking preset by simply clicking/tapping on one of the tracking preset buttons. Remember a preset can only be used to go to a target and begin tracking when it is enabled. The robotic head will move then to the preset position, obtain the target and begin tracking. Tracking will start using the face nearest the centre of the static zone. The tracking indicator

under the head selection button goes green when tracking is on.

This is the preferred method for starting tracking.

- **Using  for each head:** Use the MHC controls to position the head to the desired target and the click  to begin tracking the target.
- **Using :** Use the MHC controls to position the head(s) to the desired target and the click  to begin tracking the target for all heads. Note that this button becomes active only when tracking for at least one head is enabled.

Once tracking has started, a **green border** appears around the active preset. Also, all tracking robotic heads have  appear under head select buttons. The tracking modes appear on the LiveView display allowing the user to dynamically change the tracking mode while the head is tracking.

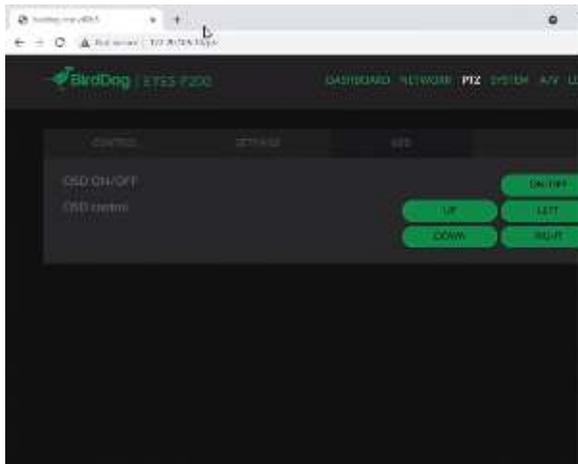


Note that when tracking is on, some of the buttons in the Configure display are inactive. These become active only after you stop tracking. You can still change the name and picture associated with the preset while tracking is on.

Note regarding Birddog Autofocus function

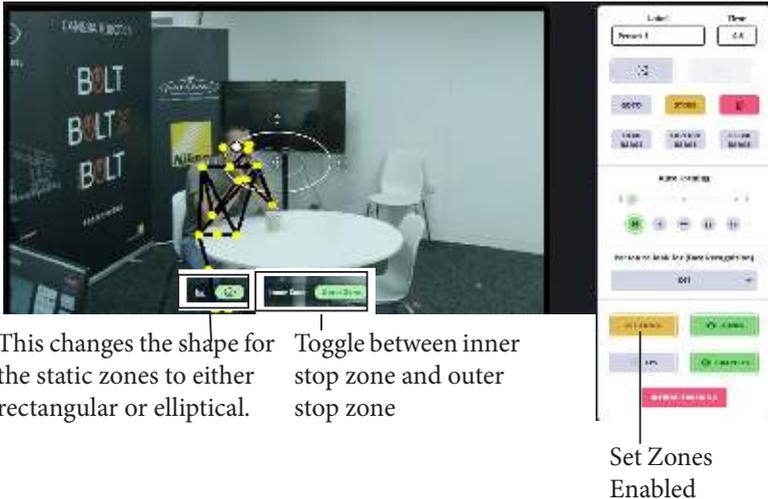
When a preset is saved with AF on, enabling it and changing the AF state will not reflect in the preset when it is enabled again. This happens because of the preset memory function in the Birddog PTZ camera. If set to ON then the complete state of the head will be saved (including AF state) when a preset is saved. If set to OFF then only the pan, tilt, zoom and focus is saved to a preset. This needs to be turned off in the on-screen display. You can access the display via NDI Studio Monitor (password: birddog).

In the OSD, go to SYSTEM --> PRESET MEMORY --> OFF. Exit the menu and close NDI Studio Monitor.



Altering Static Zones

Selecting **SET ZONES** in Configure mode for a preset shows a bar in LiveView window which allows you to edit the static zones.



Use the appearing arrows on the static zones to change the height or width of the outer or inner zone depending on what is selected. Use the centre arrows to reposition the static zone to another spot. Click the **CONFIRM** to exit Configure mode.

Once the preset is created, this control on the bottom left of liveview toggles between **edit static zone** and **choose person**.

Use the appearing arrows and other options to edit the static zones as required, and then exit the edit mode. When the little framed person icon is selected the user can choose which person on screen will be tracked. Click on the person's face to select them to be tracked



Switching Face Recognition to Another Person



When tracking with face recognition on, a toggle button of 'Deselect Person' appears in the Liveview Video allowing the user to select another person for face recognition. To use this option, stop tracking, deselect the person, move the camera so the static zone is near to the new person you want to track, then start tracking again.

Fine adjustment of autoframing zoom position

While auto-framing, if you move the zoom position control then two pairs of green horizontal lines appear in the live view. You can then fine tune the size of half body, zoom will then be adjusted by MHC to use the new size. The yellow box should fit to the green lines once the zoom had been adjusted. This is only a temporary setting, if you go to another preset, it is forgotten.



Motion Prediction

This adds a thin white line depending on which way the target is moving/ facing and gives the tracking demand an extra boost depending on the

level of the setting in the CV-Engine tab. For more information, refer to page 40.



Stopping Tracking

At any point, you can turn tracking off on all participating robotic heads by clicking/tapping .

You can stop tracking on the currently selected head by using the pan and tilt joystick control. As soon as you move the joystick the tracking will be disengaged. Another way of stopping tracking on individual robotic heads is by clicking/tapping  under the head-select button.

 can be used to stop all movement on all robots, akin to an emergency stop button.

Face Capture Page

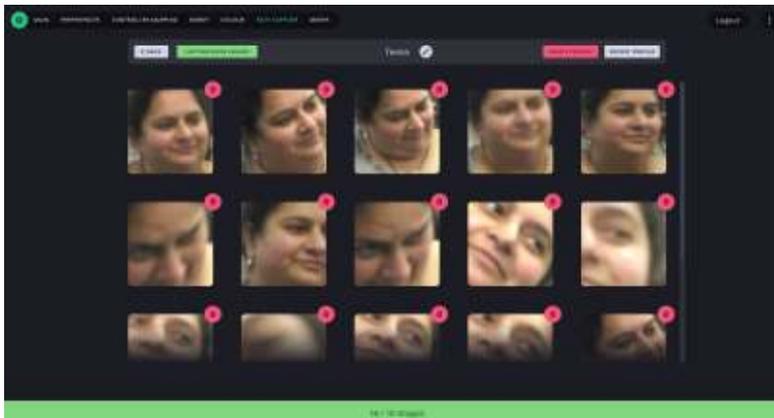
This page allows you to import and create face recognition library of people. To capture a profile:

1. Navigate to  > FACE CAPTURE.

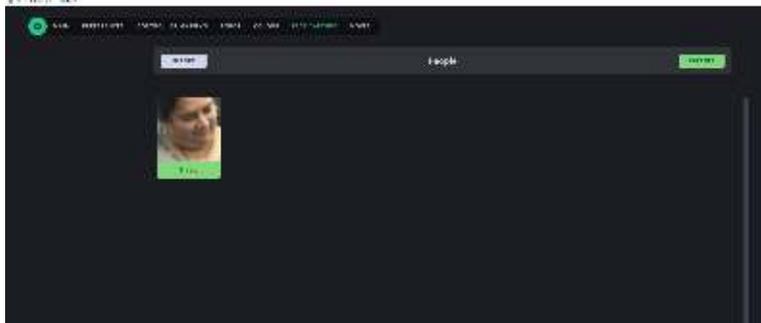
2. Tap **CAPTURE** and specify a name. Name of every profile should be different to avoid conflict in the Face Capture database.



3. Tap **START CAPTURE**.
4. Read the on-screen instructions and tap **START CAPTURING**. As the subject changes head positions and facial expressions, the Chat system will automatically capture 10 images to capture a new profile. More images can be added by clicking **CAPTURE MORE IMAGES** for more accurate face recognition.



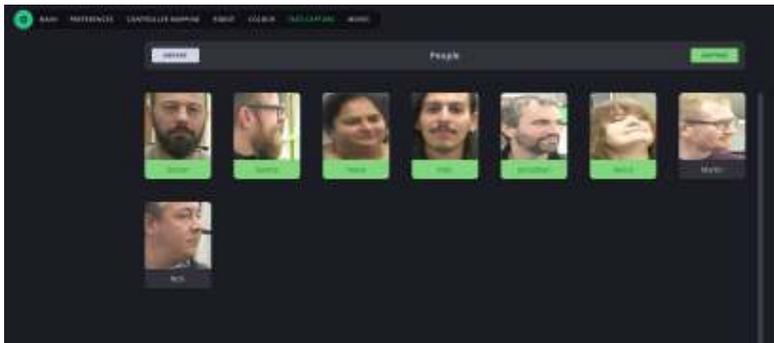
5. Click **Back** to view the Face Recognition Library.



Note

There is no limit on the number of people you can have in the database. However, it is recommended that you keep the number of active profiles down to a minimum to keep the processing time down. Each profile can be enabled/disabled in the profile manager

To disable a profile in the profile manager, click/tap a person's profile. When the profile is grey, it is disabled and will not be used for face recognition.



An enabled profile can be selected for face recognition by selecting a name in preset configuration. When tracking is started using this preset,

only that person will be tracked by this preset. Selecting 'Any' will enable tracking of all enabled profiles.



Face Recognition with Autoframing



Face Recognition with Autoframing

An unrecognised person or a disabled profile on the FACE CAPTURE page, displays as unknown in the Live View video on the main page.

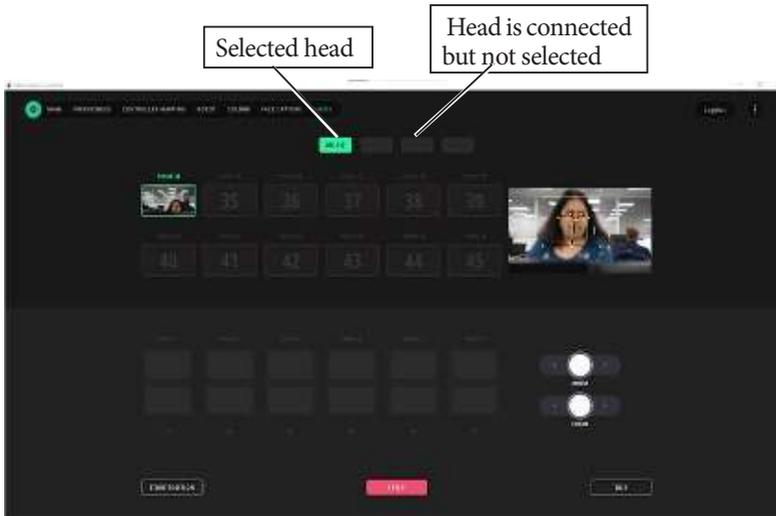
Multi-screen View

If a user is assigned multiple connected heads, the default screen after login is the Multi-screen. Click/tap the Multi-screen view () button to view the live video feed from up to 12 connected heads. By default, live controls for all heads are also available MultiView screen. You can click/tap **SELECT** the view from any of the connected heads to switch to viewing the feed from that head in the main LiveView window. You can make live tweaks to the tracking controls for each individual robot.

Selecting a head will not alter the current tracking settings on any other head. In other words, the tracking options and presets are head-specific.



Moves Page



The tabs on the page represent the heads that you can view and control using the MHC client. You can select them for operation, setting presets or defining moves.

Selecting a head

You can select an available head by clicking or tapping on it. The selected head appears as green tab, whereas any other head(s) that are connected on the network but not selected appear as light-grey tabs. Heads that are not powered up or not on the network appear as dark-grey tabs.

Presets



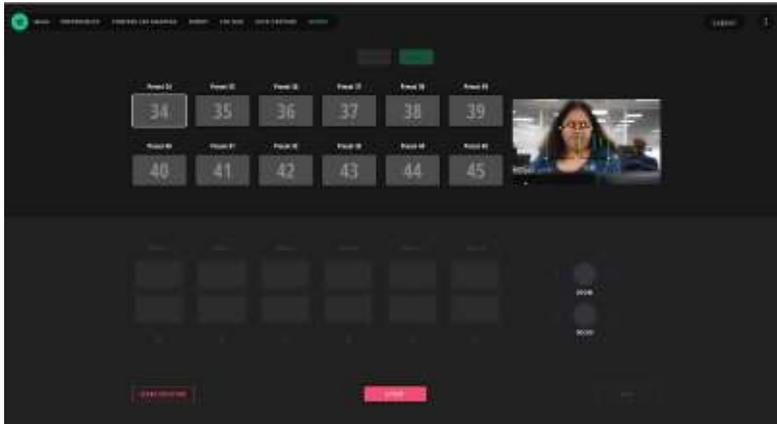
You can store the position of the head as a preset. Preset 34 to 45 are available on this page. A preset button is faded when no position is stored in them.

Storing a position as a preset

Use the following steps to store a new position or change an existing position in a preset button:

1. Use the controls to go to a head position of your choice. Ensure that the Zoom and Focus axes are in correct positions.
2. Get into store mode by clicking/tapping on the **STORE POSITION** button under the preset buttons. You will see white borders around

the **STORE** button and the preset buttons, indicating that the preset buttons can be selected to store your current head position.



3. Use the joystick controls or on-screen joystick by clicking in the Live View video to change head position. Alternatively you can use the current head position.
4. Click/tap on the preset button to store the current head position.

Activating a preset

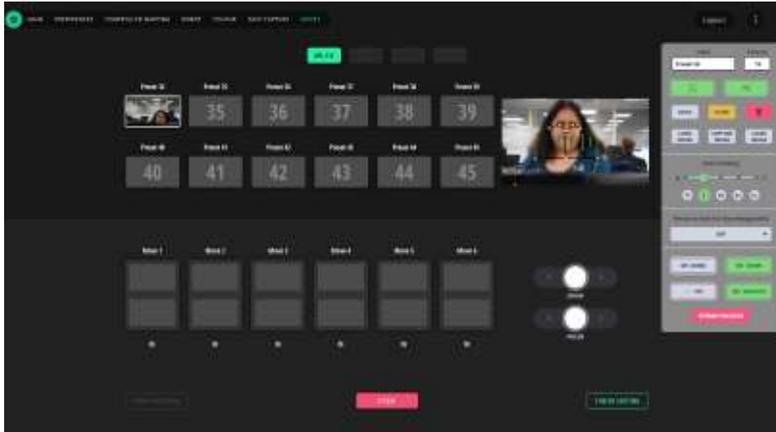
To activate a preset you simply click/tap on the preset button. A green border will appear around the preset and the head will move to the preset position.

If a Goto is in progress, you can immediately stop the movement by clicking/tapping the red **STOP** button. The speed of the robot moving into preset positions can be adjusted in the **Preferences** tab.

Editing a preset button

You can assign a name and add a picture to the preset button. To do so:

1. Click/tap the **EDIT** button.



2. Click/tap the preset button that you want to change.
3. You can specify the preset settings in the appearing Configure settings in the same way as that on the main page.
4. Click/tap **FINISH EDITTING**.

Moves

You can also create Point A-B moves to be achieved in the specified time interval. This functionality is only available for **AFC**, **Robotic Pods** and **AFC on TRH-1**.

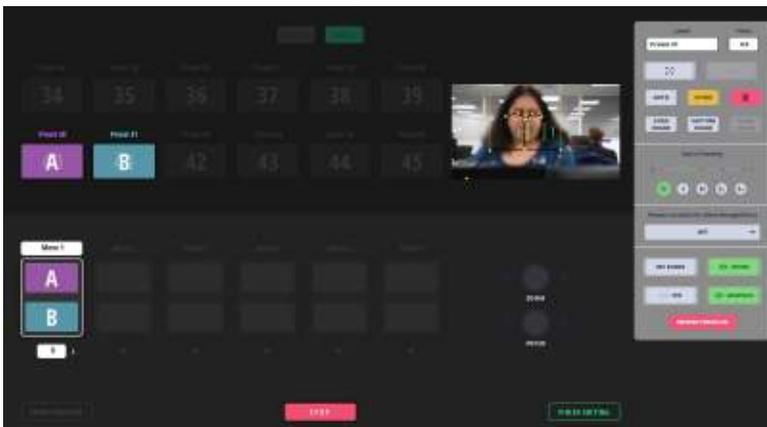
To create a move:

1. Click/tap the **EDIT** button.
2. Click/tap the move button that you want to set.
3. Click/tap **A** in the move button. Notice that the **A** icon begins to flash, indicating that it can be set.

- Click/tap a preset button to assign that to A position.



- Click/tap B in the move button.
- Click/tap a preset button to assign it to the B point.



- Enter the time you want the move to complete in. Optionally, you can also assign a name to the move.
- Click/tap **FINISH EDITTING**.



Activating a move

Like activating a preset, to activate a move, you simply click/tap on the move button. A flashing yellow border will appear around the preset and

the head will seek point A. Then, the head will seek the B point in the specified time indicated by a solid yellow border around the active move and preset button.

Stop button

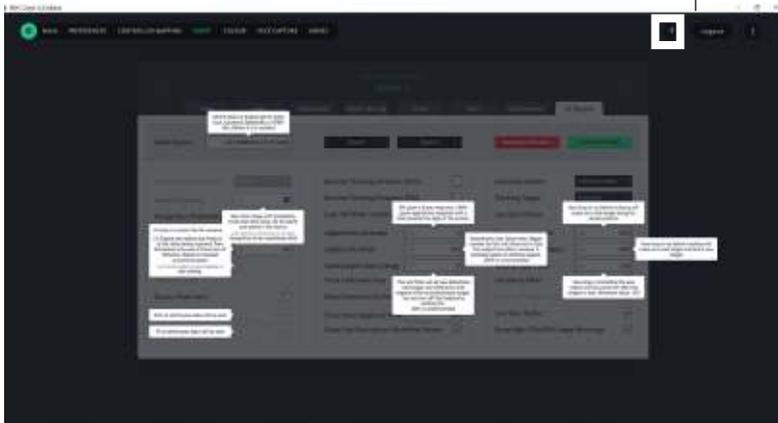
Use this button to stop a preset or a move.

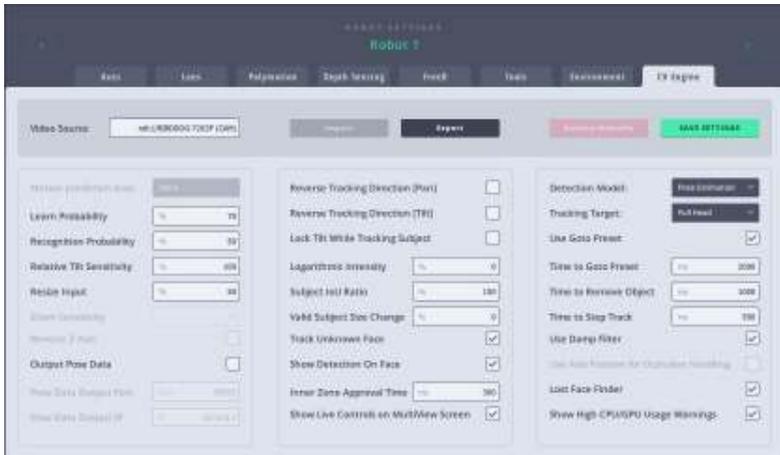
Changing Tracking Settings in the Client View

If you want to quickly change some tracking options whilst you are logged in as an engineer-type user, you can use the  > **ROBOT** > **CV Engine** tab.

Click  on top-right to display info boxes for all fields.

Help info button





Video Source: Use this box to change the Video Input for camera tracking. Simply enter the name of the input stream along with the port number (x):

- USB: **Camerax**
- Decklink: **DeckLinkx**
- RTSP: RTSP stream address
- NDI: NDI stream address

Motion prediction level: Level of prediction of direction of target movement. Default is None and can be set to Low, Medium or High. Applicable to MRMC heads only.

Learn Probability: New face image probability lower than this value will be learnt and added to the library.

Recognition Probability: Confidence threshold for a face recognition to be considered valid.

Relative Tilt Sensitivity: A factor to control the tilt movement in relation to the pan.

Resize Input: CV Engine can reduce the frame size of the captured video. Reduce this value to increase the processing speed. If resize input is over 50% then CV-Engine will run slowly.

Zoom Sensitivity: Sensitivity of zoom during auto-framing. This is based on zoom speed in axis settings.

Reverse Z axis: Toggle switch to reverse direction zoom axis in response to the moving subject.

Reverse Tracking Direction [Pan]: Reverse the direction of pan in response to moving subject.

Reverse Tracking Direction [Tilt]: Reverse the direction of tilt in response to moving subject.

Lock Tilt While Tracking Subject: When this option is turned on the robot should not tilt after the target is inside the inner stop zone.

Logarithmic Intensity: This will cause the robot to move slowly when the target is at the centre of the screen and quickly at the edge.

Subject IoU Ratio: Intersection Over Union Ratio. This is how closely you want to follow the target. It compares the bounding box of the current target with the bounding box of target in the previous frame. The default is 150% overlap, which means the position between frames is allowed to be 50% off, otherwise it is considered to be a different person. If the target is moving around quickly you need a large IoU so that the tracking is able to hold on to the target. The drawback is that the larger the IoU, the greater the chance of the tracking jumping to a different target. Hence a small IoU, such as 110% will reject false targets but will lose the intended target if they move quickly.

Valid Subject Size Change: This setting is the minimum target size filter and allows the user to set the size of the target to be detected. Default is 0, which means the setting is off, and any target will be detected regardless of size. However, it is advisable to set it at a non-zero value. For example, if a target in the background is less than half the size of the main subject, and the value is set at 50%, they will not be detected.

Track Unknown Face: When checked an unknown subject is tracked even when it is not recognised.

Show Detection on Face: When checked tracking points and lines on face are shown.

Inner Zone Approval Time: Duration in ms when the subject is confirmed to be in the inner stop zone.

Show Live Controls on MultiView Screen: Toggles showing of tracking controls on MultiView video windows.

Detection Model: Indicates whether the robotic head is a tracking head or non-tracking head.

Tracking Target: Position of the detection point (White dot), derived from the pose estimation points.

Use Goto Preset: Turning this feature on will move the robotic head to the preset position when the target is lost for more than the time set in Time to Goto Preset field.

Time to Goto Preset: How long in milliseconds after losing the target that the tracking will cease and camera will go to preset position.

Time to remove Object: This is the amount of time from when the target is lost to when the robotic head returns to the preset.

Time to Stop Track: This is the amount of time from when the target is lost to when the robotic head stops moving the motors.

Use Damp Filter: Turning this feature on will smooth out the robotic head movement when the target goes out of the outer stop zone.

Use Axis Position for Tracking: Turning this feature on will use the axis position of the robotic head to improve tracking performance.

Lost Face Finder: Automatically move the tilt upward if the subject suddenly moves out of the top of the frame.

Restore Defaults: Restores to factory default settings.

SAVE SETTINGS: Saves the settings to the current configuration.

Export: Allows you to export the settings to a file. Navigate between heads to save settings for different heads.

Import: Import settings from a file.

Polymotion Tab Settings



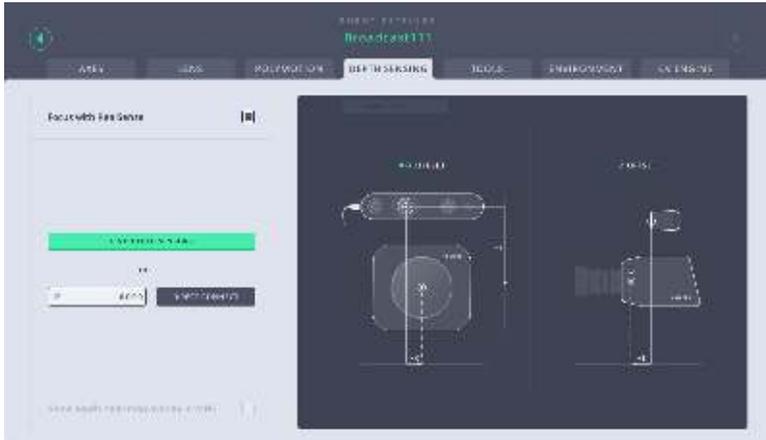
The tracking settings are normally not changed and should be left at '100%'.

Depth Sensing

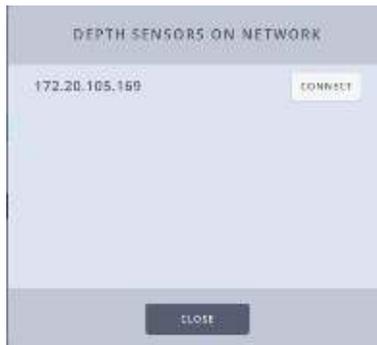
Polymotion Chat 3.0 allows the use of an external depth sensor camera for depth sensing, or sensitivity of the tracking based on the subject moving towards or away from the camera. To start using a depth sensor, mount it on the camera as required and connect it to the same network as the robotic head using a static IP address.

1. Navigate to  > **Robot** > **Depth Sensing**.
2. Select **Focus with Depth Sensor**.

3. Select **FIND DEPTH SENSORS** to automatically detect the connected sensor.

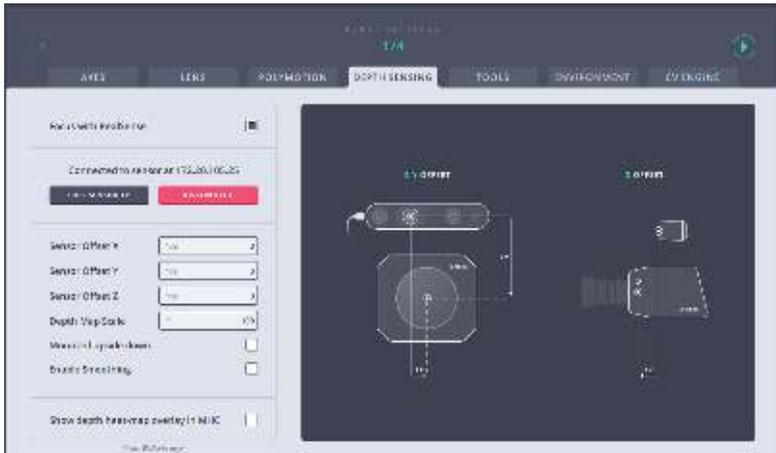


4. When the sensor is detected, click **CONNECT** and then click **CLOSE**.



5. You can instead enter the IP address of the depth sensor and click **DIRECT CONNECT** to add it manually.
6. Specify if the depth sensor is mounted upside down relative to the camera.
7. Once connected, specify the X, Y and Z camera offset values. The on-screen diagram represents the position of depth sensor with respect to the camera. If the depth sensor is mounted upside down

in relation to the camera, the diagram would reflect this. Use the diagram to help you measure the offset values.



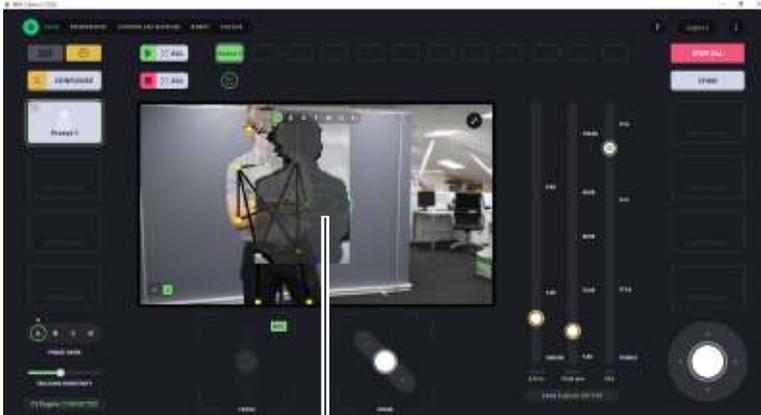
Once configured, these values do not need to be changed if the hardware configuration of the camera remains the same.

Note

The IP address of the depth sensor can be changed, in the same way the IP address of the robotic head can be changed by clicking the EDIT SENSOR IP button.

Aligning the Depth Sensing Heat Map

After you have configured the depth sensor, a heat map appears overlapping the image of the target, as follows.



Heat map not aligned

For accurate auto focusing using depth sensing, the heat map should exactly overlap the subject image from the camera. Notice that the heat map is slightly offset from the subject camera image. Adjust the physical position of the depth sensor position until the person in the video is aligned with their silhouette in the heat map. Adjust the depth sensor position until this is achieved. Lens table is must be set up for depth sensing to function accurately.



Heat map aligned



Blue dot stays central

Note

Depth sensing currently works only when there is a single target in the frame.

Polymotion Chat API

Third party software applications can now use an API to control Polymotion Chat. Broadcast studio robotic heads including MRMC robotic heads that are controlled using an existing software can use an API for Chat for subject tracking over the network from the same interface. For more information on how to use an API, contact MRMC.

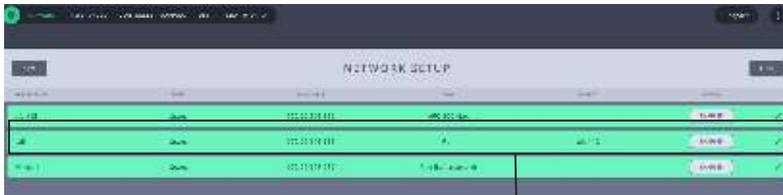
Notes

Chapter 2 Using Rail

Chat 3.0 supports addition of an AFC head moving on a Monorail slider. If your Polymotion Chat Installation contains a head moving on a Monorail, then there are some additional options on the Polymotion Chat user interface to control the speed and travel length on the rail. Tracking will continue to work through this axis.

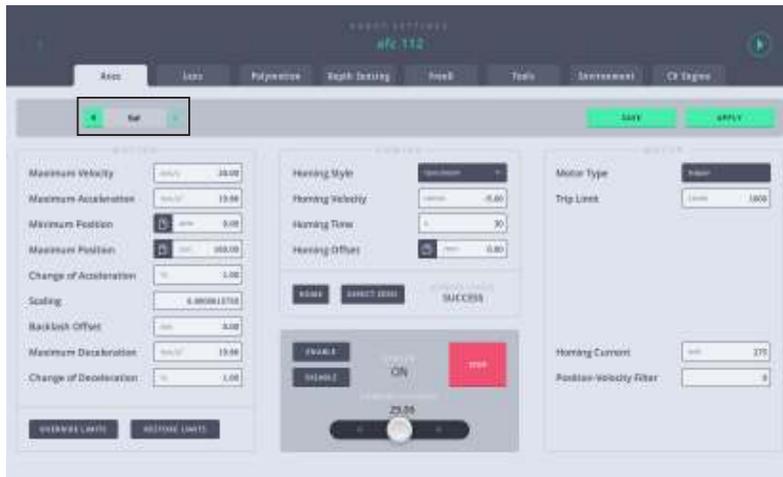
Rail Setup

If you have Rails in a system, they are configured in the network setup as the 'child' of the 'parent' head that moves along the rail.



Rail set up as 'child' of 'parent' AFC head

Once added in the parent-child manner, Rail axis appears as an additional axis in the Robot Setting page.



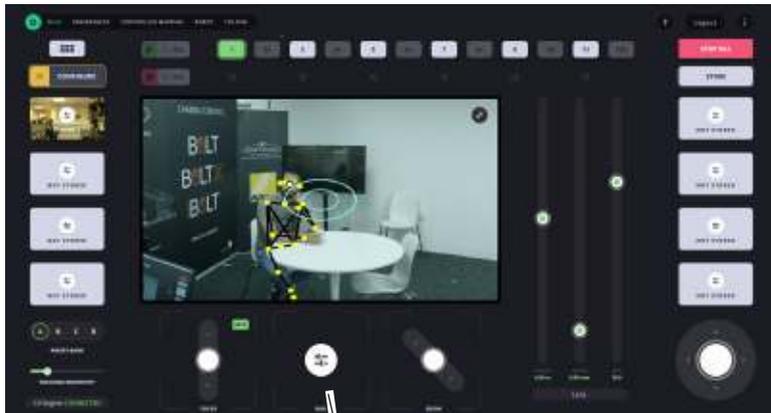
On the Preferences page, you can set limits and speed for Rail as an additional axis for the 'parent' head.



The multi-view in the Operator login appears as below showing the video feed from the camera heads installed on the rail tracks:



Configuring Rail



Configure rail button

To configure the rail, in the Operator main page, click , then click the appearing Configure Rail button. This will open the Rail Settings box.

Rail Settings



On-screen Rail slider

Configure rail mode

A and B rail presets

This mode also allows you to set the A and B points or presets between which you want the head to move on the rail.

To specify the A and B points, use the on-screen rail slider to position the head on the rail for A point and then press **STORE A** then use the joystick to go to the next position and press **STORE B**. The A and B points will be set. The green dots above the slider indicate the relative position of the A and B points on the rail.

Configure mode allows you to set:

- **Easing:** Defines the smoothness of the move. Slider more on the left means steep acceleration and deceleration while that on the right means very smooth acceleration and deceleration.
- **Speed:** Use the slider to set the speed with which the head moves on the rail.
- **Wait:** Duration for which the head will wait at a point before continuing back to the other point.

Once set, click **CONFIRM** again to start using the rail with the specified settings.

Using the Rail



A and B rail
presets

When you click **▶**, the head on the rail starts moving between the set A and B points. Use this button to pause and play if required.

Notes Regarding Rail Setup

- Rail axis settings:
 - Maximum speed: 20cm/s
 - Max acceleration: 20cm/s²
 - Maximum deceleration: 20cm/s²
- If the maximum speed is exceeded then the head might trip. Manually power cycle the head after trip.
- After every power cycle, home the rail axis:



Notes

Appendix 1 Polymotion Chat Installation and Backup

System requirements for Polymotion Chat Studio

- Dell 1U or 2U server
- OS: Windows 10 Pro
- CPU: Intel Core i9 9900 8 cores, 3.5GHz
- GPU: Nvidia RTX 4000
- RAM: 32GB (2x 16GB)
- Storage: 512GB SSD
- Video Ingest: AJA U-Tap
- The host PC has to have on board graphics on the motherboard which must be capable of running OpenGL 4.3 or higher

Installing Polymotion Chat

1. Set up the PC with a static IP address.
2. Using Black Magic Desktop Video setup software to reconfigure all the connectors on your Decklink card to be inputs.
3. Install the two main components of the Chat system, CV Engine and Polymotion Launcher. Use the correct installers depending on the system targeted for deployment:
 - Installer files required for Dell Server based Chat System [Approx. 2.5GB]
 - MHCPolymotionLauncherSetup_x64-v3.0.1.0
 - CV-Engine_Setup_Server_v3.0.1.0.exe
 - CV-Engine_Setup_Server_v3.0.1.0-1.bin
 - CV-Engine_Setup_Server_v3.0.1.0-2.bin

- Installer files required for light installation [Approx. 2GB]

Note

Light installer is used for upgrading an existing Chat System or Systems with correct graphic drivers pre-installed.

- Polymotion Launcher
- CV-Engine_Setup_Light_v3.0.1.0.exe
- CV-Engine_Setup_Light_v3.0.1.0-1.bin
- CV-Engine_Setup_Light_v3.0.1.0-2.bin

Configuring the Polymotion System

Steps in this section are performed by MRMC as part of the factory settings. However, operators can use these as a reference when troubleshooting any issues should they occur.

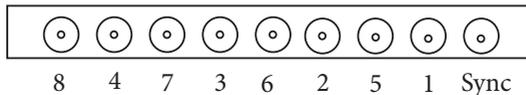
Configuring the Blackmagic DeckLink cards

If you are using Blackmagic Decklink cards for receiving the video feed in your Dell 2U server, ensure that the DeckLink receiver in the media server is configured for receiving the SDI feed from the connected cameras.

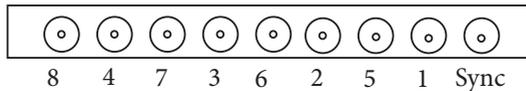
For optimum performance of the Polymotion system, you can have up to five SDI channels connected to the media server.

The port numbers configured by MRMC in the DeckLink cards (from left to right) are:

Card 1



Card 2



If this data does not accurately appear or does not correspond to the cards that are actually cabled to receive a video input from a camera, then refer to the Troubleshooting section for a workaround.

Installing Polymotion Launcher

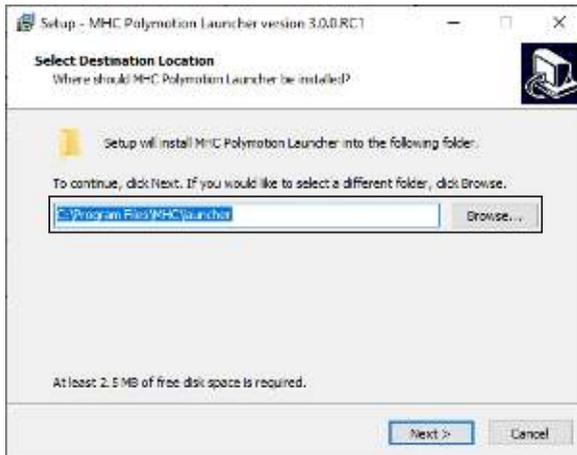
Polymotion Launcher is a utility that allows you to install additional instances of MHC corresponding to each Polymotion system, such as Polymotion Chat and Polymotion Player. Follow the instructions to install Polymotion Launcher:

1. Double-click **MHCPolymotionLauncherSetup_x64-v3.0.1.0.exe** to launch the installer for 64-bit OS installation.

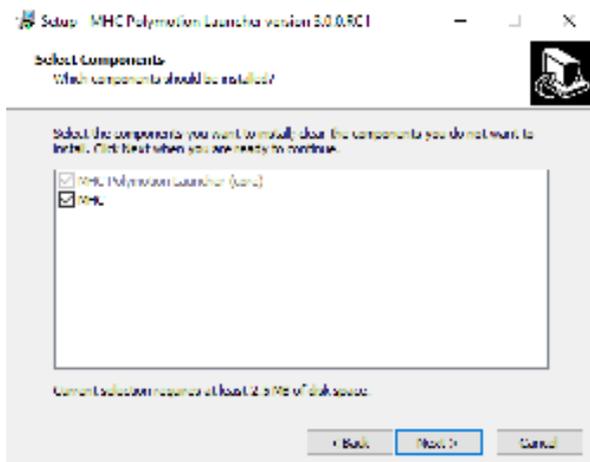
Caution

MHC v3.0 doesn't support backward compatibility from 64-bit to 32-bit installation.

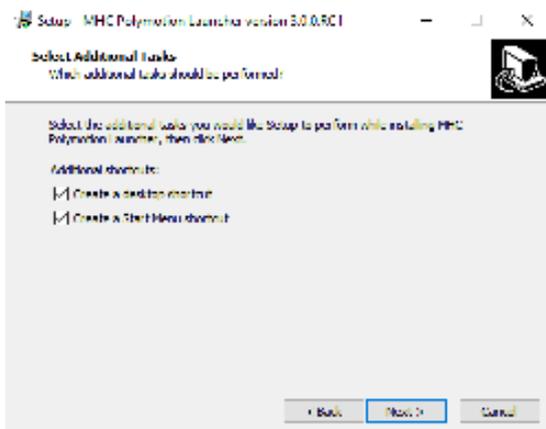
2. If not already removed, delete the MHC Server and MHC Client shortcuts from the Desktop screen.
3. Specify the location of the MHC application on your hard drive. By default it is installed in **C:\Program Files\MHC\Launcher**. Click **Next..**



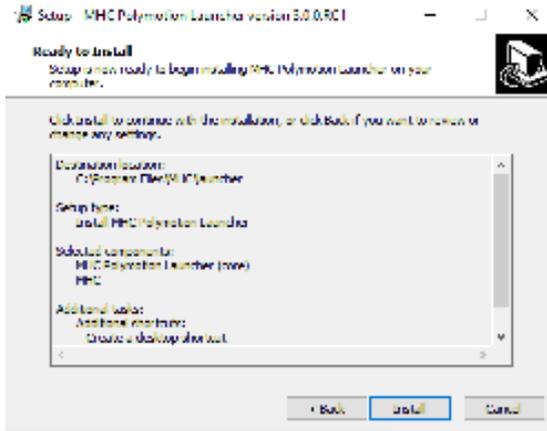
4. On the next screen, select MHC. Click **Next**.



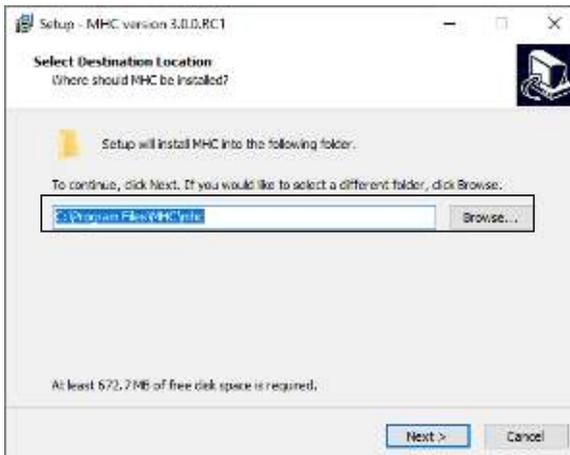
5. Click **Next**.



- The next screen summarises the components selected for install. Click **Install** to install the MHC Polymotion Launcher (Core) - the default component of all Polymotion products.

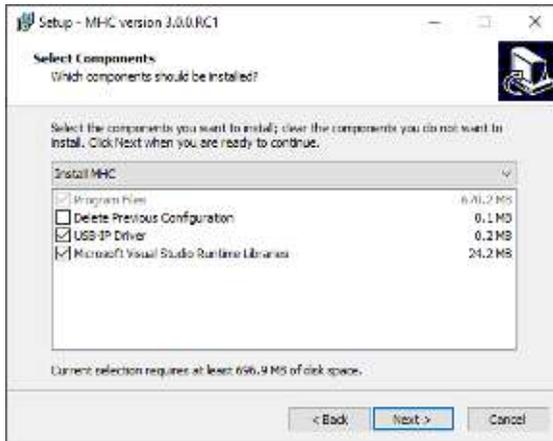


- Ensure that you choose the install location as one within the MHC folder to install MHC. Click **Next**.

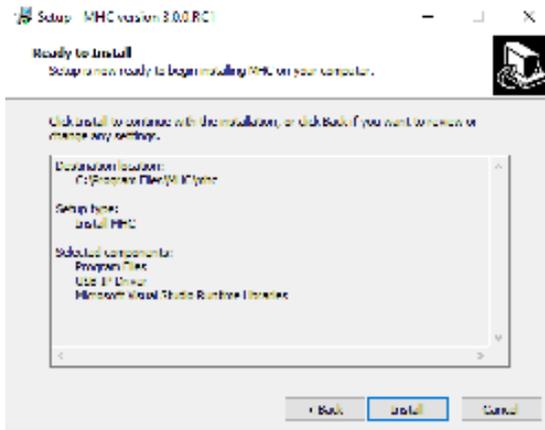


- Specify whether the installation is upgrade or a new installation and select components to install. The installer auto-selects the

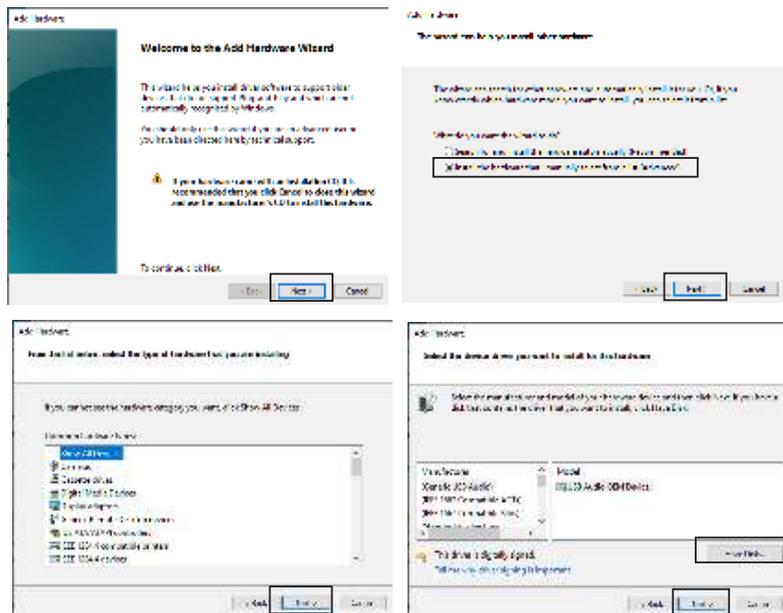
components depending on whether its a new installation or an upgrade.



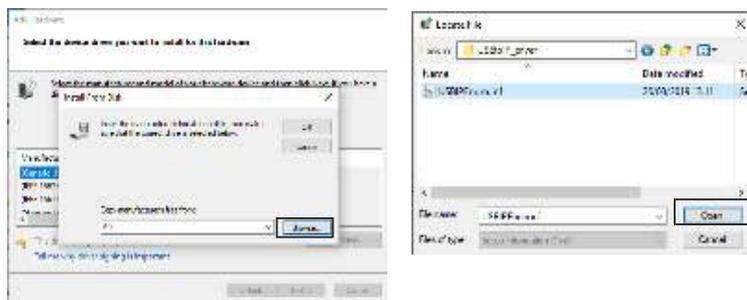
9. The next screen shows the components that are ready to be installed.

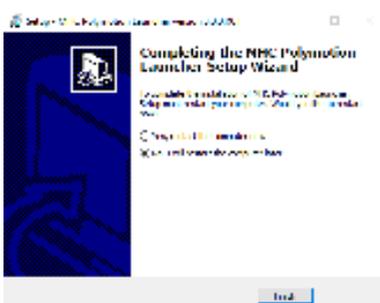
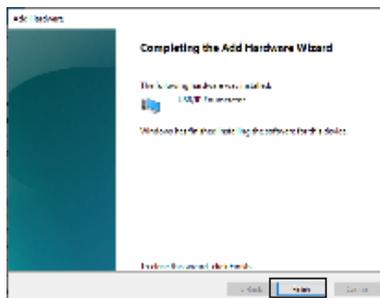
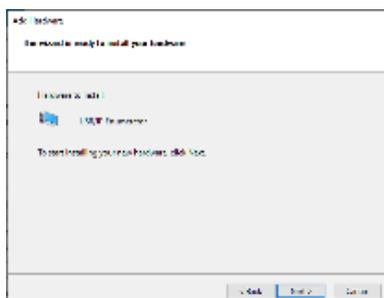
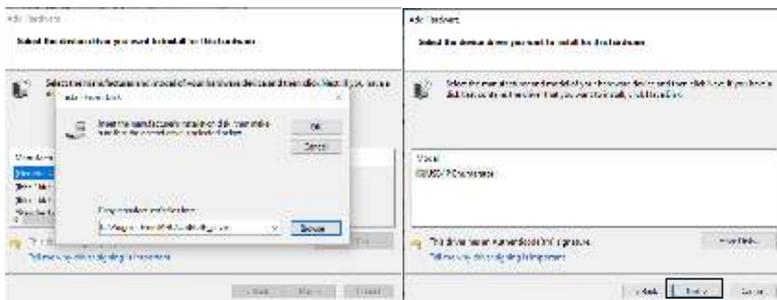


10. Follow the on-screen instructions.



11. Click **Browse** and navigate to **C:\Program Files\MHC\USBtoIP_driver\USBIPenum.inf**.

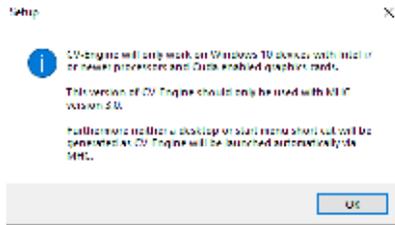




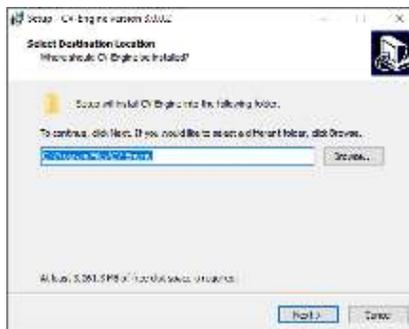
Installing CV Engine

1. After installing Polymotion Launcher, double-click **CV-Engine_Setup_Server_v3.0.0.2.exe** to start the installation. When a message appears asking for confirmation, click **Yes**.

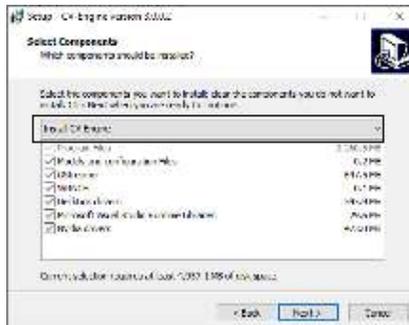
2. Click **OK** on the Setup message.



3. Select the installation folder and click **Next**. You should normally not need to change the default path.

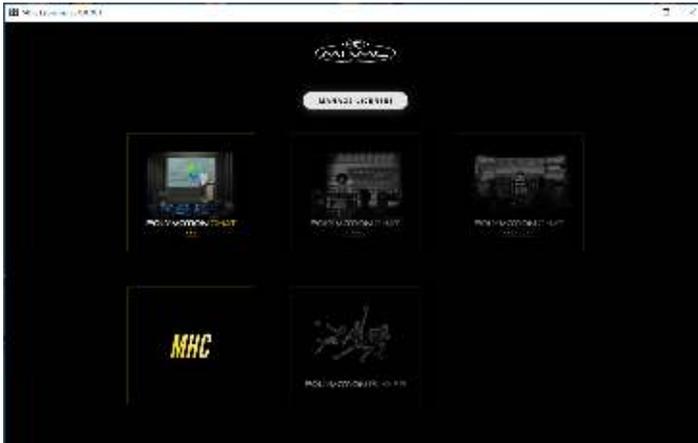


4. Click **Yes** if a message appears that the folder already exists.
5. Click **Next** to confirm installation of all the components. If this is not a new installation and you want to upgrade an existing installation, select Upgrade CV Engine from the dropdown list.



Licensing your Polymotion Product

If you have recently installed MHC, when you launch MHC Polymotion Launcher, click **Manage Licenses**.



On the Licenses window, click the Copy button the bottom of your MHC screen to copy the UID and paste it your license request including any other products such as Polymotion Chat or Polymotion Player to broadcast.support@mrmoco.com.



On the receipt of your license file, save it on to the disk, launch Polymotion Launcher. Click the **Add new licence file** button and select the new license file. Once the license is added, you will be ready to use the product.

WRNCH Licensing

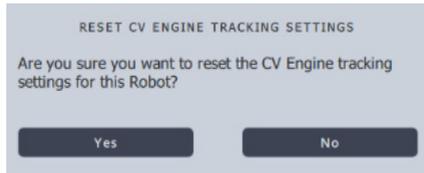
To be able to use motion tracking and face recognition with MRMC Polymotion products, you require an updated WRNCH license. This license is fixed to the machine hardware (motherboard and network device) and is permanent until 14 September 2022 to the node with Polymotion Chat Studio systems installed at the factory. After this date, perform the following to update the license:

1. After the complete installation of Polymotion Chat and CV Engine, run utility `zlmhostid.exe` (download available from TBC) on the host PC.
2. Utility will generate text file `zlmhostid.txt`. Text file will be saved to the folder from which the utility was run. Append the name of the file with PC name and Company name, for example `zlmhostid_PC79_mycompany.txt`.
3. Email the text file to Broadcast.Support@mrmoco.com along with your customer details.
 - 3.1 MRMC will then process this and email you an additional license file. **Note** that this process may take a couple of days.
4. Copy the license file you receive into folder “C:\Users*<user name>*” (where *<user name>* reflects your user details).
4. Restart your PC and launch Polymotion Chat.
 - 4.1 Polymotion Chat will now be fully licensed and ready to use.

Note: A future version of Polymotion Chat/CV Engine will remove the need for this additional licensing step.

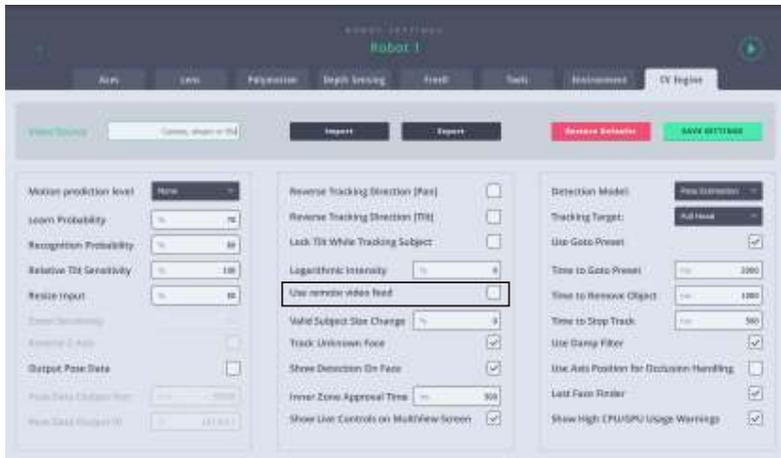
Restore Defaults

After clicking the Restore Defaults button, you will be prompted for confirmation if you really want to reset all CV Engine config. A confirmation will remove all your current settings and restore factory default values. So remember to export the settings if you need a backup because “MHCCVConfigs.xml” file saved by “SAVE SETTINGS” button will also be cleared up.



Remote Client Configuration

1. Install MHC as normal on the MHC Server machine and note that machine's IP address.
2. Install MHC with the "Client only" option on the remote client.
3. Start up client and server on their respective machines.
4. In the CV Engine tab of a MHC client, select Use Remove Video Feed.



5. If multiple servers are detected then a popup will appear to select the desired MHC server IP. Select the correct MHC server and click **SELECT**.



However, if there's only one MHC server detected, a confirmation popup appears.



MHC has now automatically configured remote video feeds for all robots.

6. Go to Chat wizard and setup the required video input feed in to CV-Engine.

Appendix 2 Troubleshooting

Resolving Video Feed issues

Blackmagic Media Express can be used to verify that decklink video feeds are connected to the correct input ports. Use the device menu to switch between inputs and view the incoming video feeds. Make sure that incoming video format is compatible with the installed Blackmagic Video Ingest card:

1. Open Blackmagic Media Express from the Windows Start Menu.
2. Select **Device> DeckLink Duo (n)**, or the port that has connection issues.
3. Select **Log and Capture** tab.



Step through the other ports to find a misplaced video feed.

Handling Lost Video Feed Issue

There is a known issue with driving Nvidia cards at high usage on Windows10. If the GPU usage is over 85% for extended periods there is a likelihood of the GPU crashing. If the GPU is from the Quadro range of cards, it can be put in to TCC mode using the following steps:

Note: For a stable CV Engine, the Graphics card should be on TCC mode.

1. Press the windows key then type “cmd”.
2. Right click on “Command Prompt” then select “Run as administrator”.
3. Go to the Nvidia SMI directory with “**cd "\Program Files\NVIDIA Corporation\NVSMI”**”.
4. Type in the command “**nvidia-smi**” and you should get a print out of information regarding the nvidia graphics cards.

```

Administrator: Command Prompt
C:\Program Files\NVIDIA Corporation\NVSMI>cd C:\Program Files\NVIDIA Corporation\NVSMI
C:\Program Files\NVIDIA Corporation\NVSMI>nvidia-smi
Sun Feb 15 16:24:56 2021

NVIDIA-SMI 450.71      Driver Version: 450.71      CUDA Version: 11.1

GPU Name          TCC/WDDM      Bus Id      Map A      Volatile Uncorr. ECC
Fan Temp  Perc  PwrUsage/Cap  Bus Id      Memory Usage  GPU Util  Comp %
-----
0  GeForce RTX 2670  NEDM      00000000:0E:00:011
0%  52C  P6  34W / 115W  00401B /  81021B  0%  Default

Processes:
GPU  GI  CI  PID  Type  Process name      GPU Memory
ID  ID  ID
-----
0  N/A  N/A  508  CIG   ...2\Winlogon\lsass.exe  N/A
0  N/A  N/A  4528  CIG   ...putApp\TextInputHost.exe  N/A
0  N/A  N/A  8740  CIG   Indullicent Permissions  N/A
0  N/A  N/A  5964  CIG   C:\Windows\explorer.exe  N/A
0  N/A  N/A  11450  CIG   ...Smith\ykyw\ScreenApp.exe  N/A
0  N/A  N/A  13690  CIG   ...kyb\888b\w\YourPhone.exe  N/A
0  N/A  N/A  14068  CIG   Indullicent Permissions  N/A
0  N/A  N/A  17604  CIG   Indullicent Permissions  N/A
0  N/A  N/A  17930  CIG   Indullicent Permissions  N/A
0  N/A  N/A  18300  CIG   ...y\Shell\ExportModeHost.exe  N/A
0  N/A  N/A  21660  CIG   ...Nkyb\888b\w\VoiceUI.exe  N/A
0  N/A  N/A  24032  CIG   ...n\4\Bios\Gsmc\launcher.exe  N/A
0  N/A  N/A  41100  CIG   ...b\w\Microsoft.Photos.exe  N/A
0  N/A  N/A  52200  CIG   Indullicent Permissions  N/A
0  N/A  N/A  57350  CIG   Indullicent Permissions  N/A
0  N/A  N/A  80260  CIG   Indullicent Permissions  N/A
0  N/A  N/A  91128  CIG   Indullicent Permissions  N/A
0  N/A  N/A  93850  CIG   Indullicent Permissions  N/A
0  N/A  N/A  95410  CIG   Indullicent Permissions  N/A
0  N/A  N/A  96310  CIG   Indullicent Permissions  N/A
0  N/A  N/A  99440  CIG   Indullicent Permissions  N/A
0  N/A  N/A  102572  CIG   Indullicent Permissions  N/A
    
```

It will tell you if the card(s) are in TCC or WDDM mode. We want TCC mode.

5. For the first graphics card type in the command “**nvidia-smi -I 0 -dm 1**” to enable TCC.
6. For a second card use “**nvidia-smi -I 1 -dm 1**” to enable TCC.

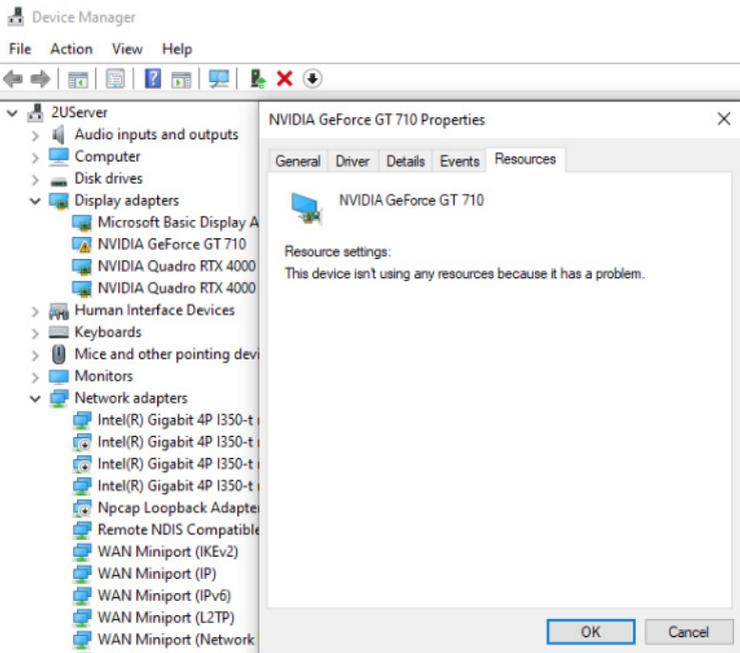
7. Reboot the system.
8. Finally, use the “`nvidia-smi`” command again to check the card(s) has been correctly set to TCC mode.

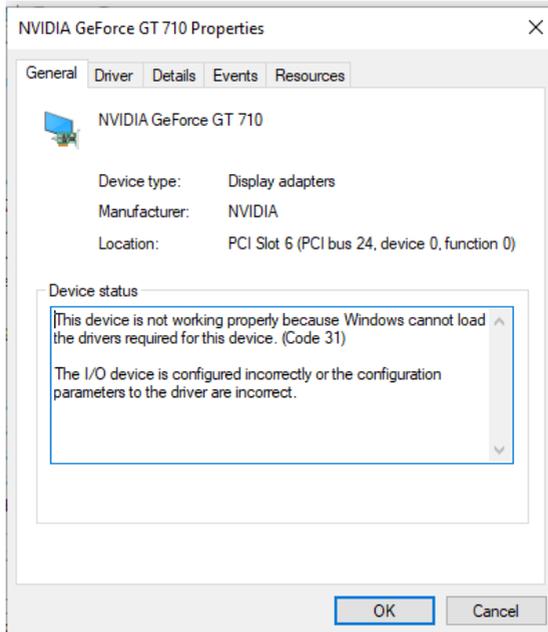
Note

When a card is in TCC mode it is in “compute only” mode so cannot be used by Windows as a graphics card. So, you must have another graphics card in the system that is non-TCC mode. It is recommended that this non-TCC mode card should not be an Nvidia card but must be able to run OpenGL 4.3 or better. This is so CV-Engine will ignore it a resource for Computer Vision processing, so it is free to handle Windows graphics tasks.

Graphic Card Device Driver Issues

The CV Engine install restarts your system and after this has happened you should verify in the Device Manager display adapters that your cards are not showing driver errors like the one below. If they are, then uninstall the device driver and then restart your machine.





Typical symptoms, causes, and actions

Symptoms	Cause and/or action
Warning appears that the tracking source is disconnected. MHC server is shut down but CV engine is still running.	Force CV Engine close via Windows Task Manager
USB Camera selected but Chat system not able to receive video.	Check Windows Firewall settings are not blocking the USB cameras.

Notes



Mark Roberts Motion Control Ltd.
Unit 3, South East Studios, Blindley Heath, Surrey RH7 6JP
United Kingdom
Telephone: +44 (0) 1342 838000
info@mrmoco.com
www.mrmoco.com

