Object Tracker User Guide

Version 1.5

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- **Real-Time Scanning:** Keep it enabled, but exclude any performance-sensitive operations involving Vizrt-specific folders, files, and processes. For example:
  - C:\Program Files\[Product Name]
  - C:\ProgramData\[Product Name]
  - Any custom directory where [Product Name] stores data, and any specific process related to [Product Name].
- **Risk Acknowledgment:** Excluding certain folders/processes may improve performance, but also create an attack vector.
- **Scan Scheduling:** Run full system scans during off-peak hours.
- **False Positives:** If behavior-based detection flags a false positive, mark that executable as a trusted application.

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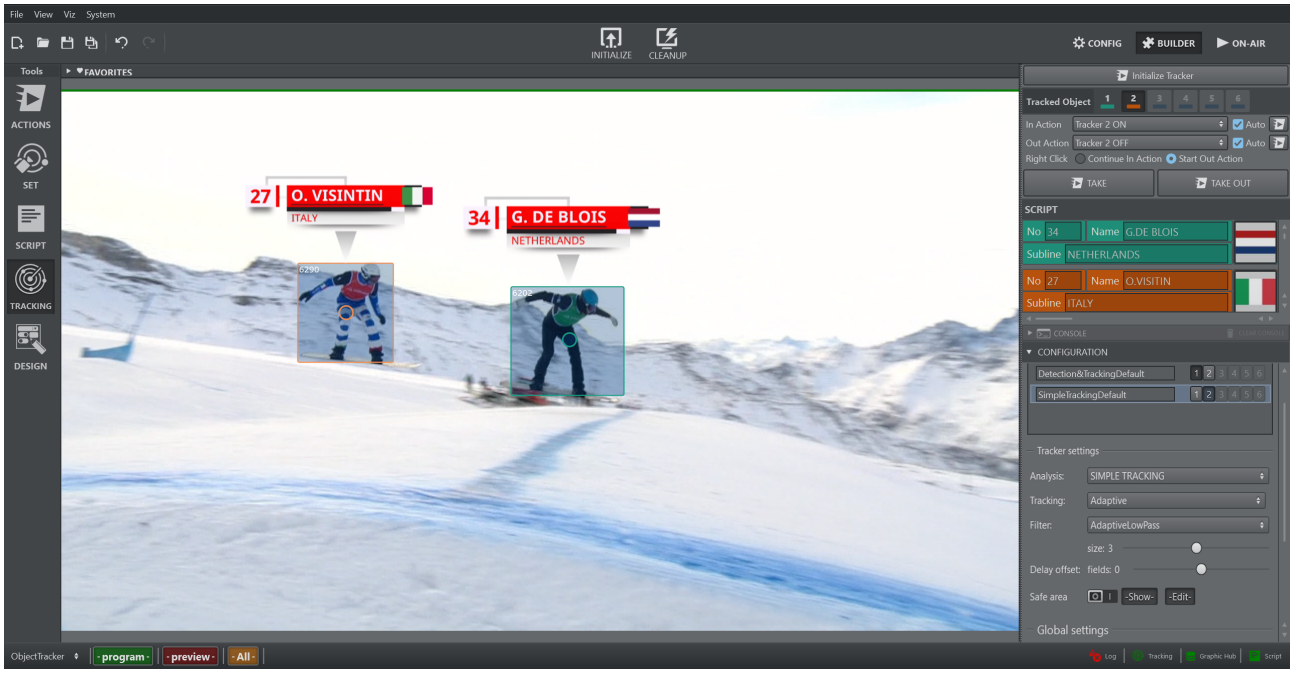
Contents

1 Introduction

1.1 About Object Tracker

Object Tracker uses Viz AI Technology to perform image-based detection and tracking of objects on an incoming video stream from a Viz Engine. The Object Tracker is separate software that must run on a machine running the Viz Engine. Viz Arc offers a front end to operate the tracker.



1.2 Related Documents

- Viz Engine Administrator Guide
- Viz Arc User Guide
- Viz Arc Script Guide

1.3 Feedback and Suggestions

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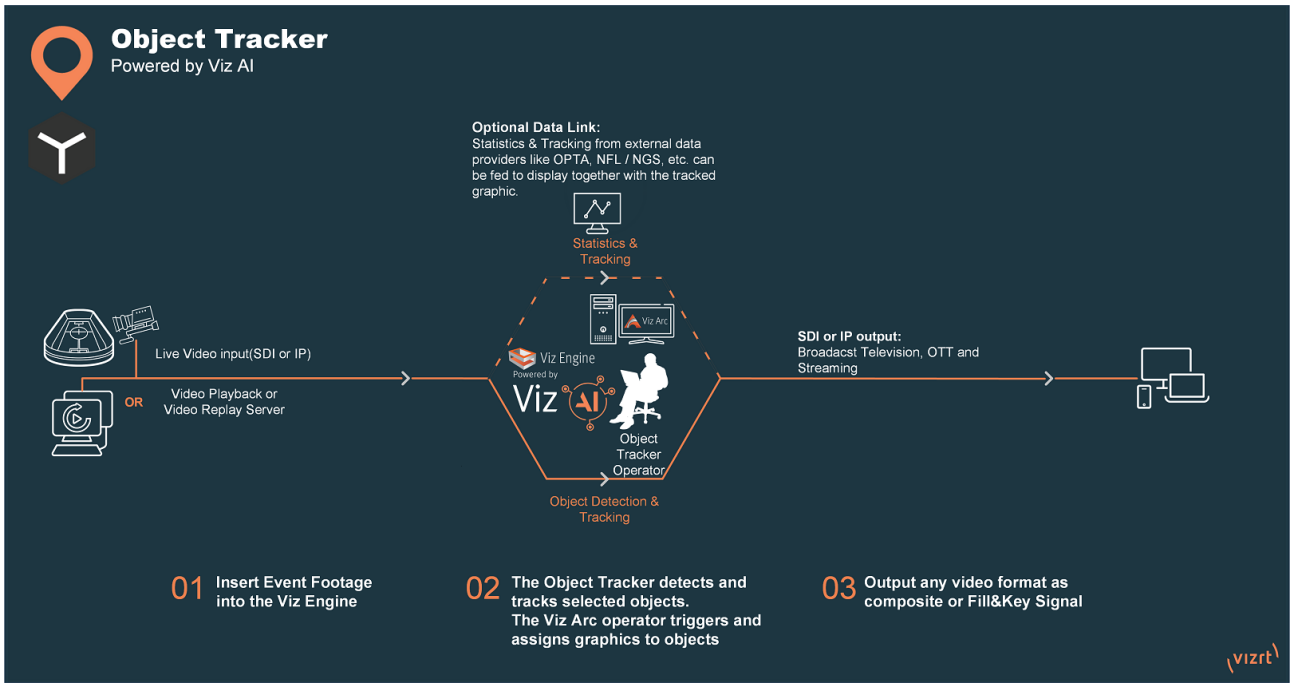
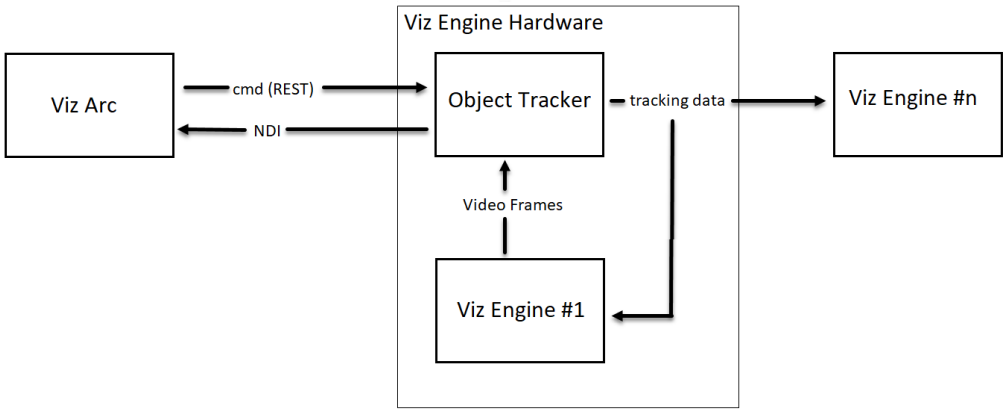
1.4 Overview



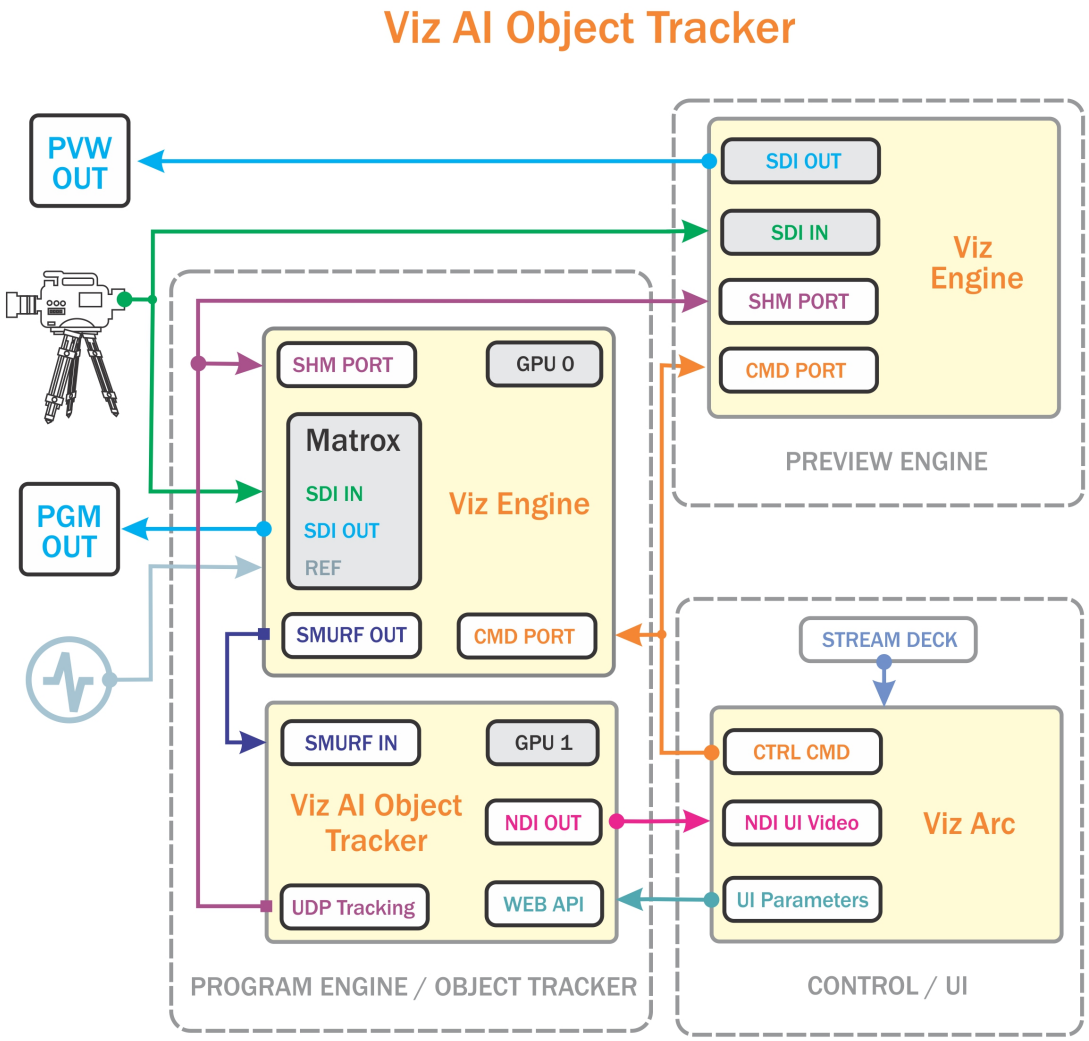
Object Tracker allows tracking individual or multiple objects within a video to focus on the key parts of the action. This fully software-based and only requires video input.



The overall system is composed of at least two machines, one running the Viz Engine and the Object Tracker and another running Viz Arc as the control application.

- **Viz Engine:** Any signal connected to the Viz Engine (for example, live SDI input, clip channel input) can be exposed to the Object Tracker where it gets processed.

- **Object Tracker:** The Object Tracker detects objects on the image stream from the Viz Engine and outputs an NDI stream of the stream and attaches the results as metadata information on each NDI image frame.
- **Viz Arc:** Viz Arc is the front end to the Object Tracker where the NDI is displayed with the respective metadata containing the detected objects. A user can select an object to be tracked. A REST command is sent to the Object Tracker to start the tracking on the selected object resulting in the generation of tracking data through Tracking Hub.



1.4.1 Tracking Modes

- **Detection and Tracking** — Object Tracker automatically finds objects in the video and draws a box around each one. Click a box to start following that object, and it keeps up automatically from there.

- **2D Pose Tracking** — Works the same way, but instead of a box it follows a person's pose — the position of their head, arms, legs, and so on.
- **Detection and Segmentation** — Instead of a box, Object Tracker outlines the exact shape of each detected object. If nothing is selected, every detected object is outlined; select one or more and only those stay outlined.
- **Simple Tracking** — Click any point in the video and Object Tracker follows it, without needing to recognize a known type of object first. Good for quick, one-off tracking, but it can lose the target if something blocks the view.
- **Manual Tracking** — A fallback for when the other modes can't keep up: hold the mouse button down to track, release to stop.

1.5 System Requirements

1.5.1 General

- Windows 10 (64-bit only)
- Windows Server 2012 R2
- Microsoft .NET 8 (Desktop Runtime and ASP.NET Core Runtime)
- CodeMeter version 6.80 and later

1.5.2 Vizrt Software

- Viz Engine version 4.4.0 and later.
- Viz Arc version 3.0.0 and later.

1.5.3 Minimum Hardware Requirements

720p, 1080i, 1080p

Object Tracker

- 1x HP Z8 or Dell R7920
- 2x RTX 4000 or better
- 1x Matrox DSXLE4 or better

Viz Arc

- HP Zbook Mobile Workstation

OR

- 1x HP Z4
- 1x RTX 2000

Information: Viz Arc must run on separate Hardware than the Object Tracker.

SDI Preview

If there is a requirement for an SDI Preview in addition to the SDI PGM OUT, an additional Object tracker box is required.

1.5.4 Antivirus

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2 Installation

2.1 Requirements

2.1.1 NVIDIA GPU & Driver

An NVIDIA GPU with compute capability **7.5 or higher** is required (Turing architecture and newer — GeForce RTX 20-series and up, Quadro RTX, Tesla T4, and all NVIDIA data-center GPUs from Turing through Blackwell).

> ⚠ **Maxwell, Pascal, and Volta GPUs are no longer supported** (e.g. GeForce GTX 900/10-series, Quadro P-series, Tesla V100). Check your card against NVIDIA's CUDA GPU compute capability list before installing.

Install an NVIDIA display driver version **>= 580.65.06**. Download drivers from NVIDIA.

2.1.2 Bundled dependencies

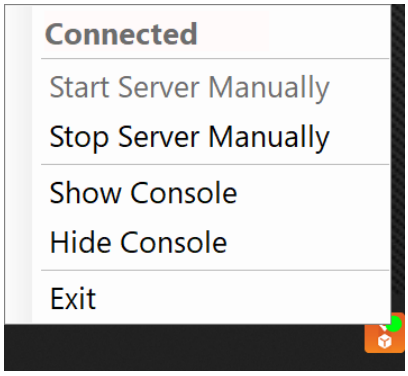
CUDA 13.0, TensorRT 10.13.3.9, cuDNN 9.x, NDI, Intel IPP, PyTorch, and cuVSLAM runtime libraries, as well as the Microsoft Visual C++ Redistributable and .NET 8 runtimes, are installed automatically by the Viz Object Tracker installer below. No separate downloads or manual copy steps are required.

2.2 Installer

- Run the installer — it extracts its bundled files into a temporary folder.
- Windows may briefly show a User Account Control prompt while the installer silently installs its bundled prerequisites (Microsoft Visual C++ Redistributable and .NET runtimes) — this is expected, allow it.
- Accept the license terms to continue the installation.
- Then the installer will copy all the necessary files.
- Press **Finish** to complete installation.
- Once the installation finishes, Object Tracker starts automatically, and shows up with a green light in the icon tray.
- The installer adds Object Tracker into the **Startup Apps** so it starts up automatically after logging in.

2.2.1 Icon Tray

Right click the icon tray to get a context menu.

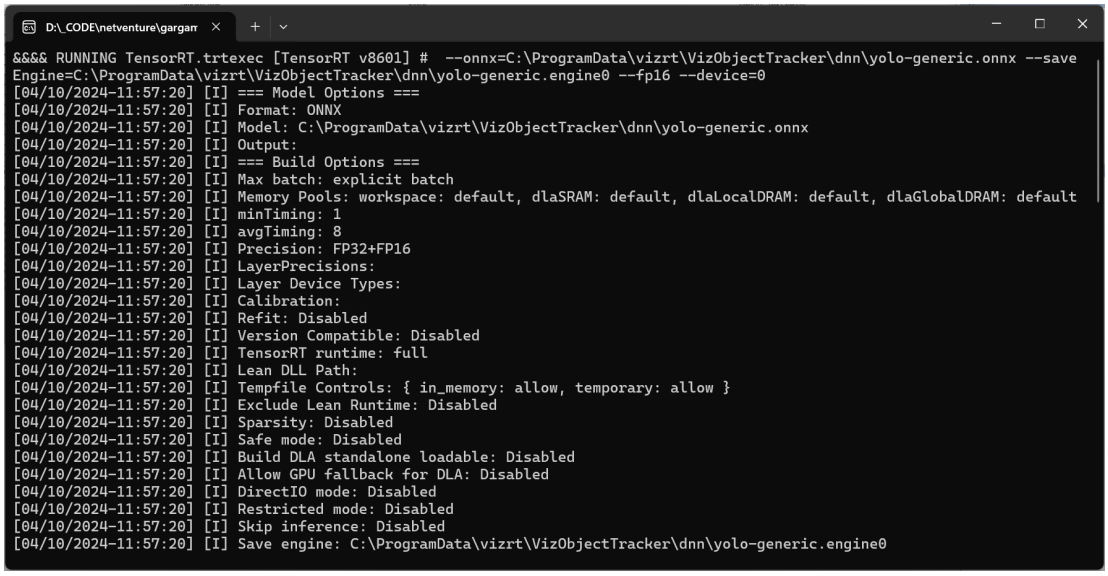


- **Connected/Disconnected:** Indicates whether the Object Tracker is running.
- **Start Server Manually:** Starts the service in case it has stopped.
- **Stop Server Manually:** Stops the service.
- **Show Console:** Visualizes the console with debugging information.
- **Hide Console:** Hides the console.
- **Exit:** Stops the service and closes the icon tray.

2.3 First Power up

Once everything is installed properly, before starting the Object Tracker, the generic dataset model has to be compiled for every CUDA graphic card located in the workstation. This process takes few minutes for each graphic card.

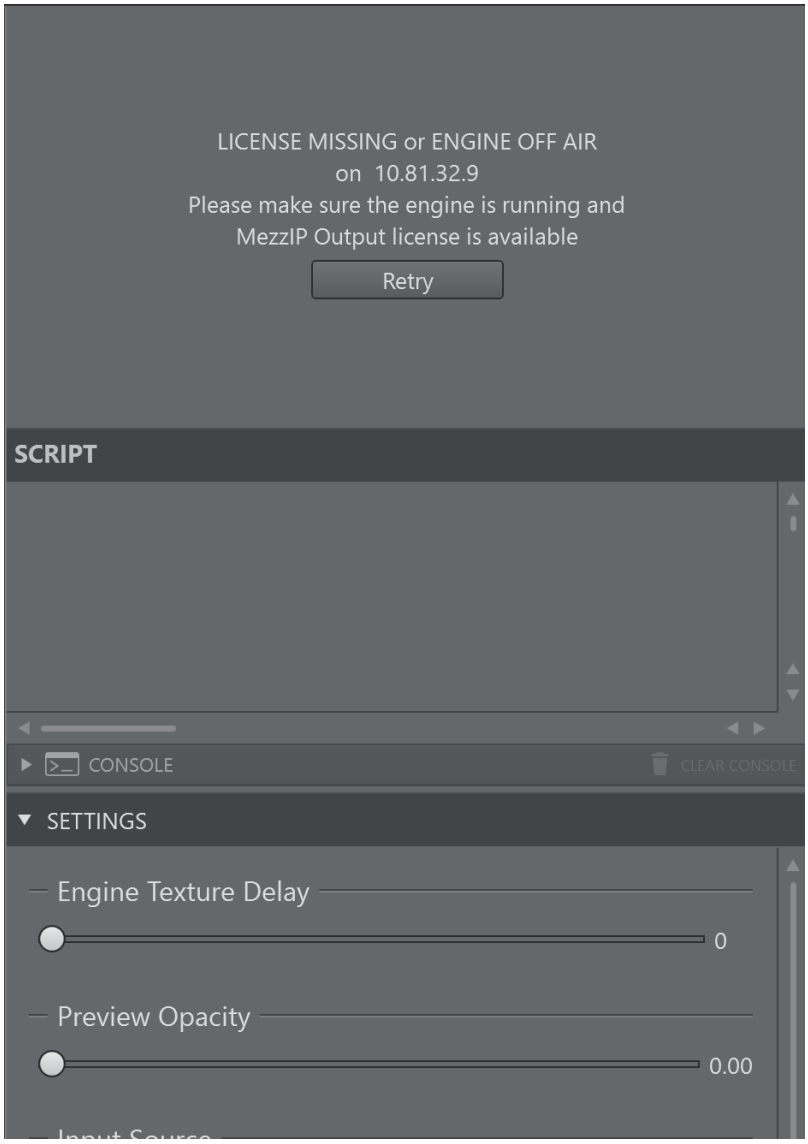
Before compiling the model for a GPU, the installer waits (up to 60 seconds) for that GPU's utilization to drop to **3% or below**. TensorRT's build-time tactic/kernel selection is timing-sensitive, so if something else is actively using the GPU during compilation, it can pick a meaningfully slower tactic set for that engine. While it waits, it lists which process(es) are currently using the GPU so you can close them — closing other GPU-heavy applications before this step is recommended for the best-performing engine. If the GPU is still busy after 60 seconds, compilation proceeds anyway.



3 Prerequisites

After installing **Object Tracker** and after enabling and configuring the server in Viz Arc, you should see a green light in the status bar and an additional **TRACKING** button on the left hand tool bar in the Viz Arc UI.

- Load an appropriate scene on the renderer, a sample archive containing a scene can be found in the Viz Arc installation folder (*C:/Program Files/vizrt/VizArc <version>/Resources/ObjectTracker).*
- Viz Engine needs to run on Matrox based hardware.
- Make sure you have the **Object Tracker license** on the Viz Engine where the **Object Tracker** is running.

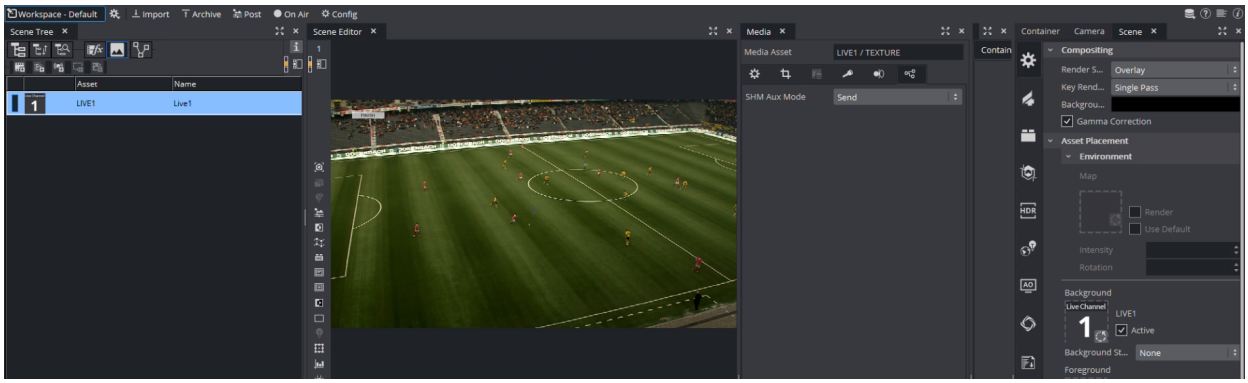


In case the license is missing or Viz Engine is offline, an error message appears as shown above.

4 Viz Scene Design

This section describes how to design a scene to be used with the object tracker.

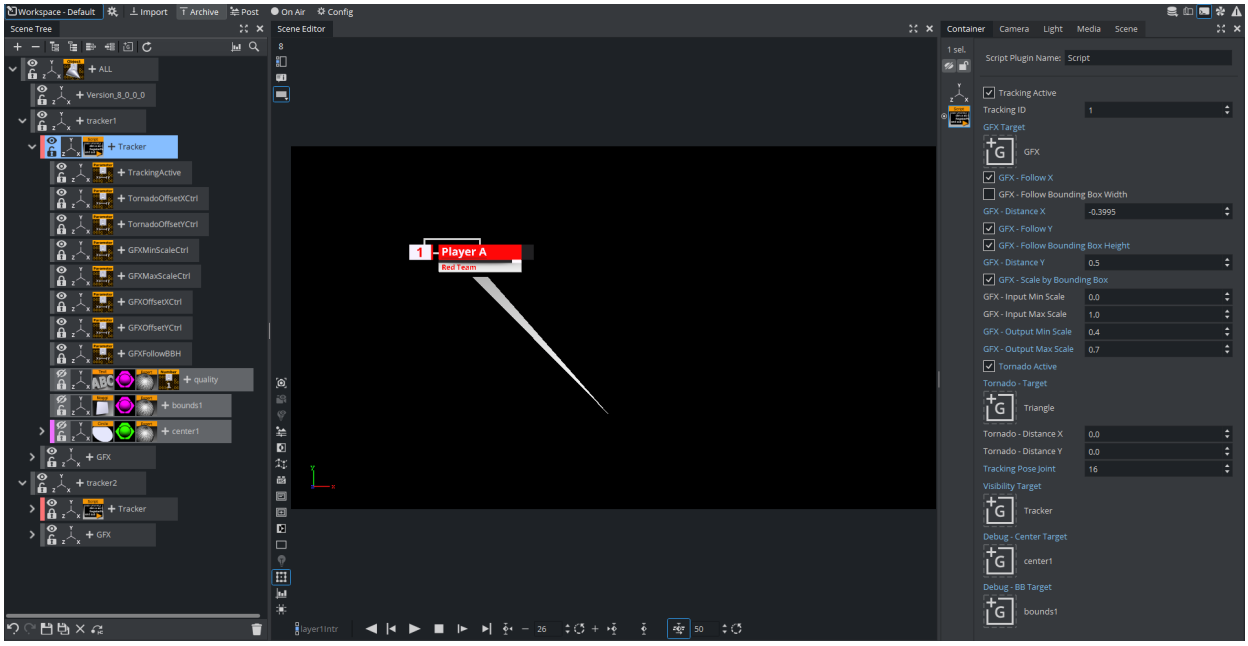
4.1 Live Video Input



The most important setting of a scene that can be used with the Object Tracker is the live input. The **SHM Aux Mode** must be set to *Send*. This allows the Object Tracker to read the input surface from the Engine. The Live Input asset needs to be present in the scene but does not necessarily need to be visible, so the result can be still composed on an external mixer.

It is possible to use other texture source such as clip channels. You need to make sure that the **SHM Aux Mode** is set to *Send* and that the configured **Input Key** (see **Configuration > Tracking** in the Viz Arc User Guide) matches the **SHMAuxKey** configuration of the Object Tracker's Viz Engine (for example, *viz_clip1_aux*, *viz_live1_aux*, etc.).

4.2 Script



4.2.1 Tracking Script

As the tracking data comes into Viz Engine through shared memory, these values need to be read and translated into screen coordinates. This can happen through the following script:

```
Dim trackerID = 0
Dim screenWidth as Double
Dim screenHeight as Double
Dim mpi = 3.14159265359
Dim degToRad = mpi / 180.0
Dim currentTrackingType as String

Structure tracked
    x as Double
    y as Double
    width as Double
    height as Double
    valid as Integer
    score as Double
End Structure

Structure trackedObjects
    'TIMECODE
    tc as Integer
```

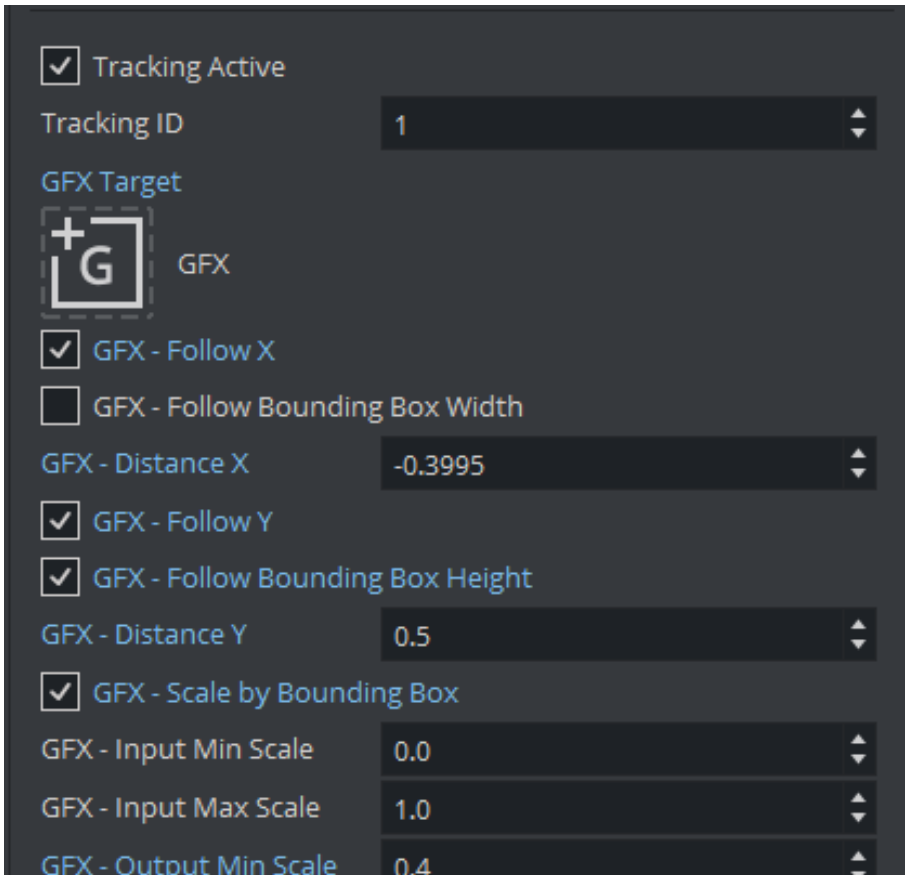
```
    'TRACKED OBJECTS
    tos as Array[tracked]
End Structure

Structure Point3D
    x as Double
    y as Double
    z as Double
End Structure

Structure pose
    valid as Integer
    skeleton as Array[Point3D]
End Structure

Structure poseObjects
    'TIMECODE
    tc as Integer
    'POSE OBJECTS
    ps as Array[pose]
End Structure

Sub OnInit()
    'do some trigonometry to get the screen width/height on the 0 plane.
    'this calculation works in orto and perspectiv mode but the camera needs
    'to look straight down the z axis (no rotation). Works well with the
    'default camera settings
    screenWidth =
tan(scene.CurrentCamera.Fovx*0.5*degToRad)*scene.CurrentCamera.Position.z*2
    screenHeight =
tan(scene.CurrentCamera.Fovy*0.5*degToRad)*scene.CurrentCamera.Position.z*2

    VizCommunication.map.RegisterChangedCallback("PoseObjects")
    VizCommunication.map.RegisterChangedCallback("TrackedObjects")
End Sub

Dim somethingToShow as Boolean
Dim pos as Vertex
Dim rot as Vertex
Dim scale as Double
Dim bbHeight as Double
Dim bbWidth as Double
Dim quality as Double

Sub Move()
    Dim bbTarget     = GetParameterContainer("bbTarget")
    Dim centerTarget = GetParameterContainer("centerTarget")
    Dim gfxTarget    = GetParameterContainer("gfxTarget")

    centerTarget.position.x = pos.x
    centerTarget.position.y = pos.y

    centerTarget.Rotation.x = rot.x
```

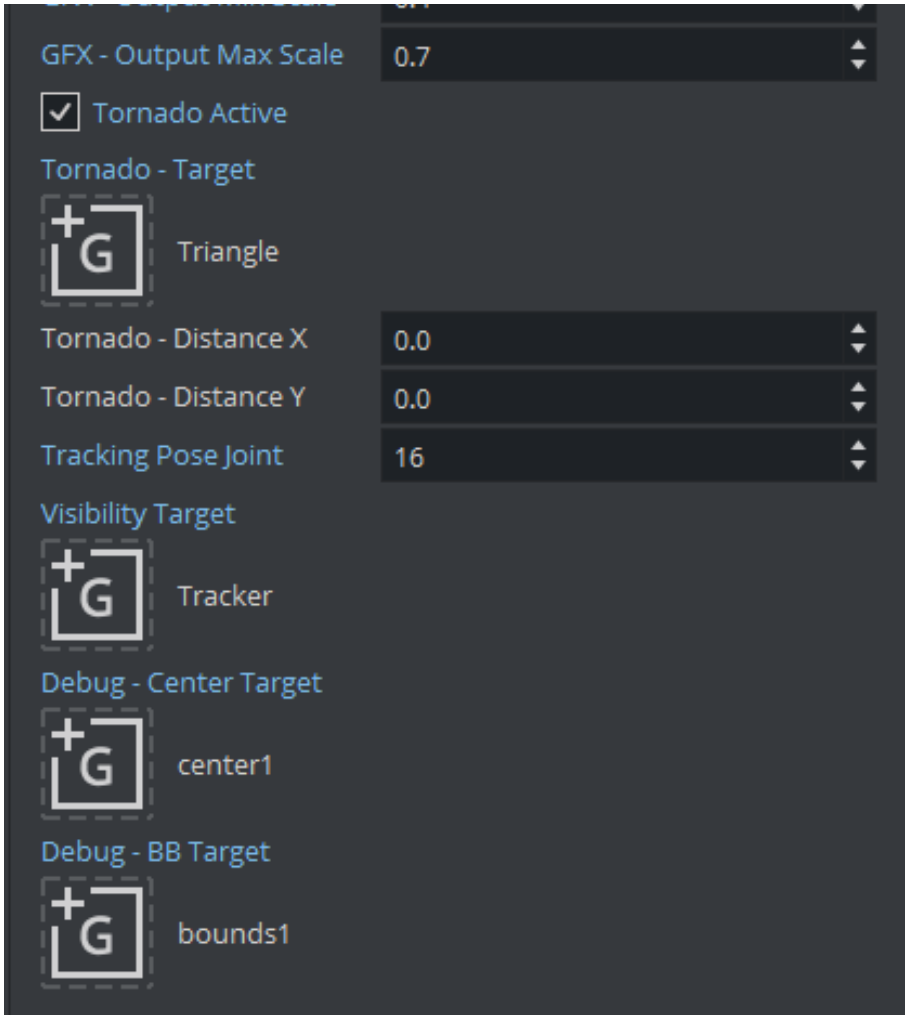
```
    centerTarget.Rotation.y = rot.y
    centerTarget.Rotation.z = rot.z

    centerTarget.Scaling.x = scale
    centerTarget.Scaling.y = scale
    centerTarget.Scaling.z = scale

    bbTarget.position.x = pos.x
    bbTarget.position.y = pos.y
    bbTarget.Scaling.x  = bbWidth  / 100
    bbTarget.Scaling.y  = bbHeight / 100

    if GetParameterBool("gfxFollowX") == true Then
        if(GetParameterBool("gfxFollowBBX") == true) then
            gfxTarget.position.X = pos.X + (bbWidth + GetParameterDouble("gfxDeltaX")
* screenWidth) * 0.5
        else
            gfxTarget.position.X = pos.X + GetParameterDouble("gfxDeltaX") * 0.5 *
screenWidth
        end if
    end If

    if GetParameterBool("gfxFollowY") == true Then
        If(GetParameterBool("gfxFollowBBY") == true) then
            gfxTarget.position.Y = pos.Y + (bbHeight +
GetParameterDouble("gfxDeltaY") * screenHeight) * 0.5
        Else
            gfxTarget.position.Y = pos.Y + GetParameterDouble("gfxDeltaY") * 0.5 *
screenHeight
        End if
    End If

    if GetParameterBool("gfxDoScale") == true Then
        Dim inMin as Double
        Dim inMax as Double
        Dim outMin as Double
        Dim outMax as Double
        Dim gfxScale = bbHeight

        inMin = GetParameterDouble("gfxInMinScale")
        inMax = GetParameterDouble("gfxInMaxScale")

        outMin = GetParameterDouble("gfxOutMinScale")
        outMax = GetParameterDouble("gfxOutMaxScale")

        gfxScale = Max(inMin, gfxScale)
        gfxScale = Min(inMax, gfxScale)

        gfxScale = (gfxScale-inMin)/(inMax-inMin)
        gfxScale = outMin + gfxScale*(outMax-outMin)

        gfxTarget.scaling.x = gfxScale
        gfxTarget.scaling.y = gfxScale
```

```
        gfxTarget.scaling.z = gfxScale
    End If

    Dim tornadoActive as Boolean
    tornadoActive = GetParameterBool("tornadoActive")
    If tornadoActive Then
        Dim tornadoTarget = GetParameterContainer("tornadoTarget")
        Dim loc = tornadoTarget.WorldPosToLocalPos(pos)

        tornadoTarget.GetGeometryPluginInstance().SetParameterDouble("x3", loc.x +
GetParameterDouble("tornadoDeltaX") * bbWidth / gfxTarget.scaling.x)
        tornadoTarget.GetGeometryPluginInstance().SetParameterDouble("y3", loc.y +
GetParameterDouble("tornadoDeltaY") * bbHeight / gfxTarget.scaling.y)
    End If
End Sub

Sub ObjectTracking()
    Dim trObjects as trackedObjects
    trObjects = (trackedObjects)VizCommunication.Map["TrackedObjects"]

    somethingToShow = trObjects.tos.Size > trackerID
    If (somethingToShow) Then
        somethingToShow = trObjects.tos[trackerID].valid == 1
    End If

    If (somethingToShow) Then
        pos.x    =  trObjects.tos[trackerID].x * screenWidth
        pos.y    = -trObjects.tos[trackerID].y * screenHeight
        bbWidth  =  trObjects.tos[trackerID].width  * screenWidth
        bbHeight =  trObjects.tos[trackerID].height * screenHeight

        rot.x = 0.0
        rot.y = 0.0
        rot.z = 0.0
        scale = 1.0

        Move()

        quality  = trObjects.tos[trackerID].score

findSubContainer("quality").GetFunctionPluginInstance("ControlNum").SetParameterStrin
g("input", cStr(quality*100.0))
    End If
End Sub

Sub PoseTracking()
    Dim jointIdx = GetParameterInt("trackingJoint")
    Dim pObjects as poseObjects
    pObjects = (poseObjects)VizCommunication.Map["PoseObjects"]

    somethingToShow = pObjects.ps.Size > trackerID
    If (somethingToShow) Then
        somethingToShow = pObjects.ps[trackerID].valid == 1
```

```
    End If

    If (somethingToShow) Then
        pos.x =  pObjects.ps[trackerID].Skeleton[jointIdx].x * screenWidth
        pos.y = -pObjects.ps[trackerID].Skeleton[jointIdx].y * screenHeight
        'pos.z =  pObjects.ps[trackerID].Skeleton[jointIdx].z

        rot.x = 0.0
        rot.y = 0.0
        rot.z = 0.0
        scale = 1.0
        bbHeight = 0
        bbWidth = 0

        Move()
    End If
End Sub

Sub OnExecPerField()
    trackerID = GetParameterInt("trackingID") - 1

    Dim trackingActive as Boolean
    trackingActive = GetParameterBool("trackingActive")

    If(trackingActive) Then
        If( currentTrackingType == "TrackedObjects") Then
            ObjectTracking()
        ElseIf( currentTrackingType == "PoseObjects") Then
            PoseTracking()
        End If
    End If

    Dim visibilityTarget = GetParameterContainer("visibilityTarget")

    visibilityTarget.Active = trackingActive AND somethingToShow
    this.Active = trackingActive AND somethingToShow
End Sub

Sub OnInitParameters()
    RegisterParameterBool("trackingActive", "Tracking Active", True)
    RegisterParameterInt("trackingID", "Tracking ID", 1, 1, 9)

    RegisterParameterContainer("gfxTarget", "GFX Target")
    RegisterParameterBool("gfxFollowX", "GFX - Follow X", False)
    RegisterParameterBool("gfxFollowBBX", "GFX - Follow Bounding Box Width", False)
    RegisterParameterDouble("gfxDeltaX", "GFX - Distance X", 0.0, -1000000, 1000000)
    RegisterParameterBool("gfxFollowY", "GFX - Follow Y", False)
    RegisterParameterBool("gfxFollowBBY", "GFX - Follow Bounding Box Height", False)
    RegisterParameterDouble("gfxDeltaY", "GFX - Distance Y", 0.0, -1000000, 1000000)

    RegisterParameterBool("gfxDoScale", "GFX - Scale by Bounding Box", False)

    RegisterParameterDouble("gfxInMinScale", "GFX - Input Min Scale", 0.0, 0, 1.0)
```

```
    RegisterParameterDouble("gfxInMaxScale", "GFX - Input Max Scale", 1.0, 0, 1.0)

    RegisterParameterDouble("gfxOutMinScale", "GFX - Output Min Scale", 0.0, 0,
1000000)
    RegisterParameterDouble("gfxOutMaxScale", "GFX - Output Max Scale", 1.0, 0,
1000000)

    RegisterParameterBool("tornadoActive", "Tornado Active", False)
    RegisterParameterContainer("tornadoTarget", "Tornado - Target")
    RegisterParameterDouble("tornadoDeltaX", "Tornado - Distance X", 0.0, -1000000,
1000000)
    RegisterParameterDouble("tornadoDeltaY", "Tornado - Distance Y", 0.0, -1000000,
1000000)

    RegisterParameterInt("trackingJoint", "Tracking Pose Joint", 0, 0, 32)

    RegisterParameterContainer("visibilityTarget", "Visibility Target")
    RegisterParameterContainer("centerTarget", "Debug - Center Target")
    RegisterParameterContainer("bbTarget", "Debug - BB Target")
End Sub

Sub OnSharedMemoryVariableChanged(map As SharedMemory, mapKey As String)
    currentTrackingType = mapKey
End Sub
```





In a first step, the script calculates in the **OnInit** method the available width and height of the viewport on the zero Z plane. In the **OnExecPerField** method, the tracking data is read out using a given shared memory keys.

The **TrackingID** parameter selects the tracked point to follow in the tracking points data structures (it represents also the Tracked Object Input ID in the Viz Arc interface).

The script uses the **GFX Target** (that represents the tracked point), it is used very much like the Autofollow plug-in. Additionally it uses a few more parameters that determine an additional offset relative to the tracked object's bounding box.

- **GFX - Follow X:** Allows the graphics follow the horizontal movement of the tracked object.
- **GFX - Follow Bounding Box Width:** Positions the graphics on the right hand side of the bounding box.
- **GFX - Distance X:** Adds constant horizontal offset.
- **GFX - Follow Y:** Allows the graphics follow the vertical movement of the tracked object.
- **GFX - Follow Bounding Box Height:** Aligns the graphics on top of the bounding box.
- **GFX - Distance Y:** Adds constant vertical offset.
- **GFX - Scale by Bounding Box:** Uses Bounding Box size to scale graphics.
- **GFX - Input Min Scale:** Sets minimum input scale of the Bounding Box height. The input height is normalized between 0 and 1 (where 1 is the full screen height, 0.1 is 10% of the screen height etc.).

- **GFX - Input Max Scale:** Sets maximum input scale of the Bounding Box height. The input height is normalized between 0 and 1 (where 1 is the full screen height, 0.1 is 10% of the screen height etc.).
- **GFX - Output Min Scale:** Maps minimum output scale of the graphics.
- **GFX - Output Max Scale:** Maps maximum output scale of the graphics.

Using the above sample values, a bounding box with height of 0.05 or smaller (thus 5% of the screen height or smaller) results in a scaling of 0.4 (Output Min Scale). A bounding box of height 0.2 or larger (20% or larger of the screen height) is scaled to 0.7.

All values in between 0.05 and 0.2 are interpolated linearly between 0.4 and 0.7. Adjust those values to suit your graphics. The sample in this script considers only the height of the bounding box, but it could be easily changed to consider the surface of the bounding box or the width only.

The checkbox **Tornado Active** enables both the visualization and the evaluation of the position of the **Tornado - Target.**

It can be customized through:

- **Tornado - Distance X:** The horizontal offset from the tracked point.
- **Tornado - Distance Y:** The vertical offset from the tracked point.

The **Tracking Pose Joint** selects the landmark to be used as tracked point.

The script then switches on and off the target container defined in the **Visibility Target** parameter when tracking begins and tracking ends or is lost. This can be also replaced with a stage command for example.

The parameter container **Debug - Center Target** is updated on every field to the "check" the actual tracking position.

> **Parent Transformations:** The script above does not consider any parent transformations of the target container. Make sure the target container contains no additional parent transformations.

The **Debug - BB Target** container parameter (which might contain a Noggi or Rectangle plug-in) gets resized according to the tracked width and height of the object.

> **Bounding Box Sizes:** The bounding box sizes might become zero. This is always the case for simple and manual tracking.

4.2.2 Data Structures

Detection and Tracking, Simple Tracking and Manual Tracking

Each frame the Object Tracker updates the VizCommunicationMap variable with key *TrackedObjects*. It contains the structure shown below:

```
Structure tracked
    x as Double
    y as Double
    width as Double
    height as Double
    valid as Integer
    score  as Double
```

```
End Structure

Structure trackedObjects
    'TIMECODE
    tc as Integer
    'TRACKED OBJECTS
    tos as Array[tracked]
End Structure
```

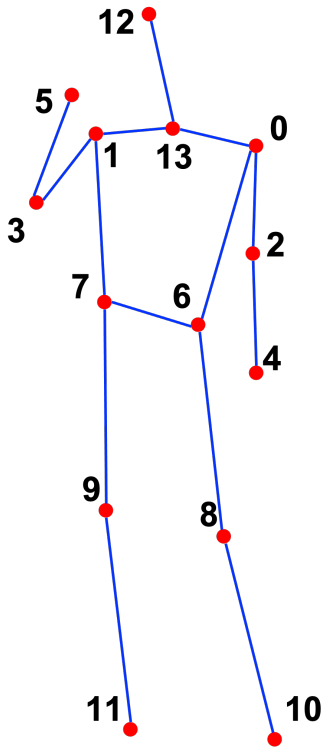
The *trackedObjects* structure contains an array of nine *tracked* structures (the maximum number of objects that can be tracked); the parameter *valid* shows whether the object is actually tracked. The position inside the array matches the InputID used when the object was selected.

2D Pose Tracking

Each frame the ObjectTracker updates the VizCommunicationMap variable with key *PoseObjects.* It contains the structure shown below:

```
Structure Point3D
    x as Double
    y as Double
    z as Double
End Structure

Structure pose
    valid as Integer
    skeleton as Array[Point3D]
End Structure

Structure poseObjects
    'TIMECODE
    tc as Integer
    'POSE OBJECTS
    ps as Array[pose]
End Structure
```

The *poseObjects* structure contains an array of nine *pose* structures (the maximum number of objects that can be tracked); the parameter *valid* shows whether the object is actually tracked. The position inside the array matches the InputID used when the person was selected. The *skeleton* array is filled as follows:

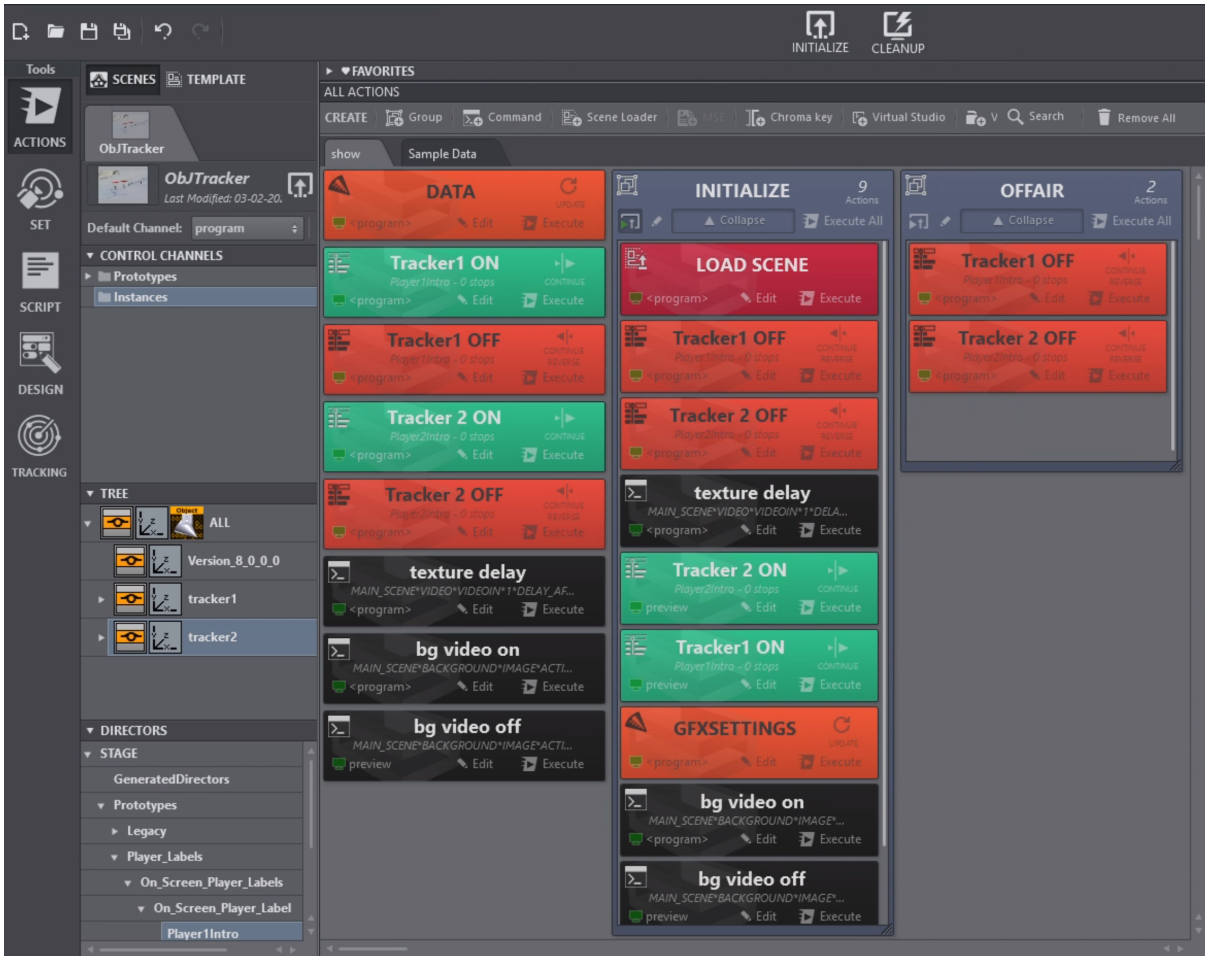


0: 'left_shoulder',
1: 'right_shoulder',
2: 'left_elbow',
3: 'right_elbow',
4: 'left_wrist',
5: 'right_wrist',
6: 'left_hip',
7: 'right_hip',
8: 'left_knee',
9: 'right_knee',
10: 'left_ankle',
11: 'right_ankle',
12: 'top_head',
13: 'neck'.

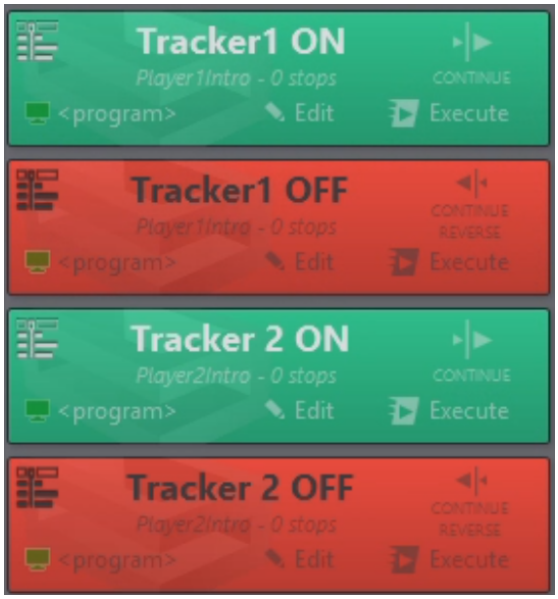
If a landmark is not detected, its coordinates are outside the screen (x:-1.0 y:-1.0 z:-1.0).

5 Preparing Operations

Before being able to put graphics On Air, you need to define actions or templates that can bring those graphics in and out. Those actions can vary from simply switching on and off scene containers, to animating in and out directors or more complex templates.



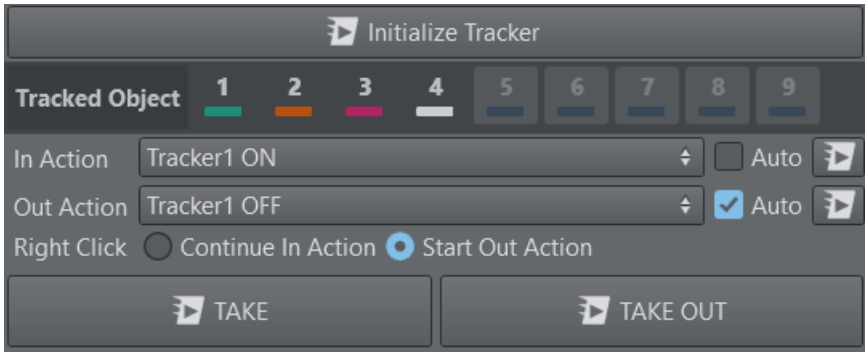
For example, each tracker has a director action animating the graphics in and out respectively.



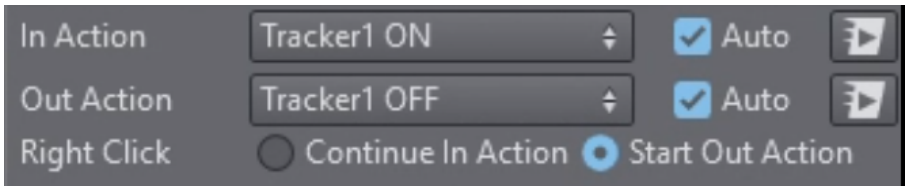
Those actions can be used to trigger an in animation when starting to track object and an out animation when the tracking is lost or the operator takes it Off Air.

5.1 Tracking Panel

This panel allows you to define which actions to execute for in and out and it allows you to operate the graphics.



5.1.1 In/Out Actions



Select an **In Action** from the dropdown that should be triggered when an object is selected for tracking.

Select an **Out Action** from the dropdown that should be triggered when an object is de-selected for tracking or when tracking is lost.

Check **Auto** checkboxes when those actions should be executed automatically on selection of a tracked object and when the object is lost respectively.

The execute push buttons can be used to execute the actions manually. Clicking using the right mouse button on the execute action buttons executes the respective actions on the preview channel.

Under the option Right Click select what should happen when the user clicks the right mouse button on a tracked object or when tracking is lost. Either Start Out Action that means to execute what is selected as Out Action or select Continue In Action that execute a continue on the selected In Action. The latter option might be useful when the selected In Action is a template that might execute its continue as the Out Action.

5.1.2 Take and Take Out

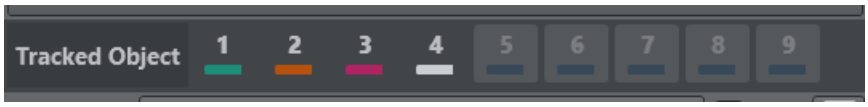
When clicking the **Take** button, all currently actively tracked trackers are executed their predefined **In Action**. The keyboard shortcut **SPACEBAR** might be used instead.

When clicking the **Take Out** button, all trackers execute their predefined **Out Action**. The keyboard shortcut **BACKSPACE** might be used instead.

Clicking using the right mouse button on the buttons executes the respective actions on the preview channel.

5.1.3 Tracked Object

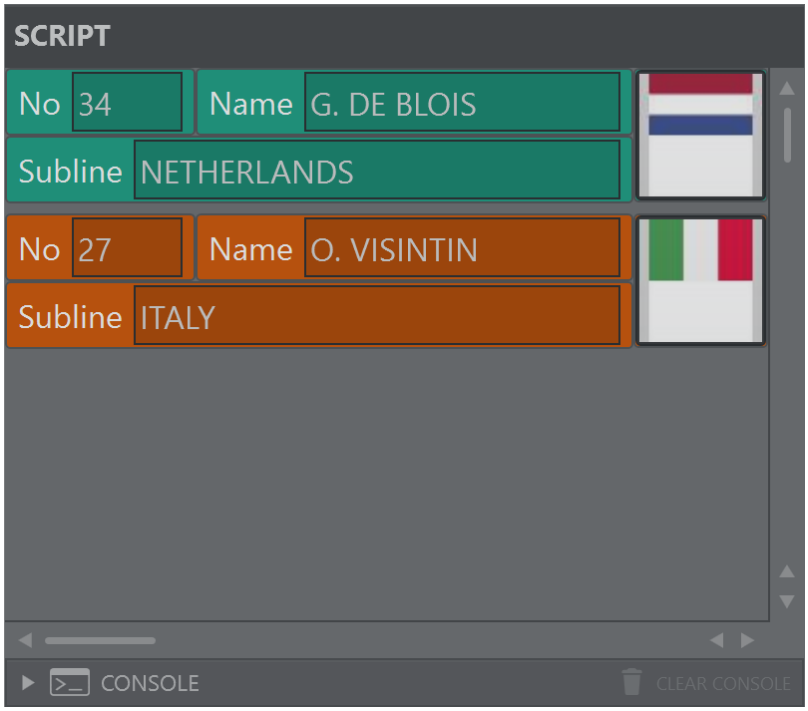
Select the active tracker from the available trackers.



The **Keyboard Shortcut Tab** allows you to switch from one active tracker to the next. It is also possible to directly activate a tracker by pressing the keyboard numbers from **1** to **9**.

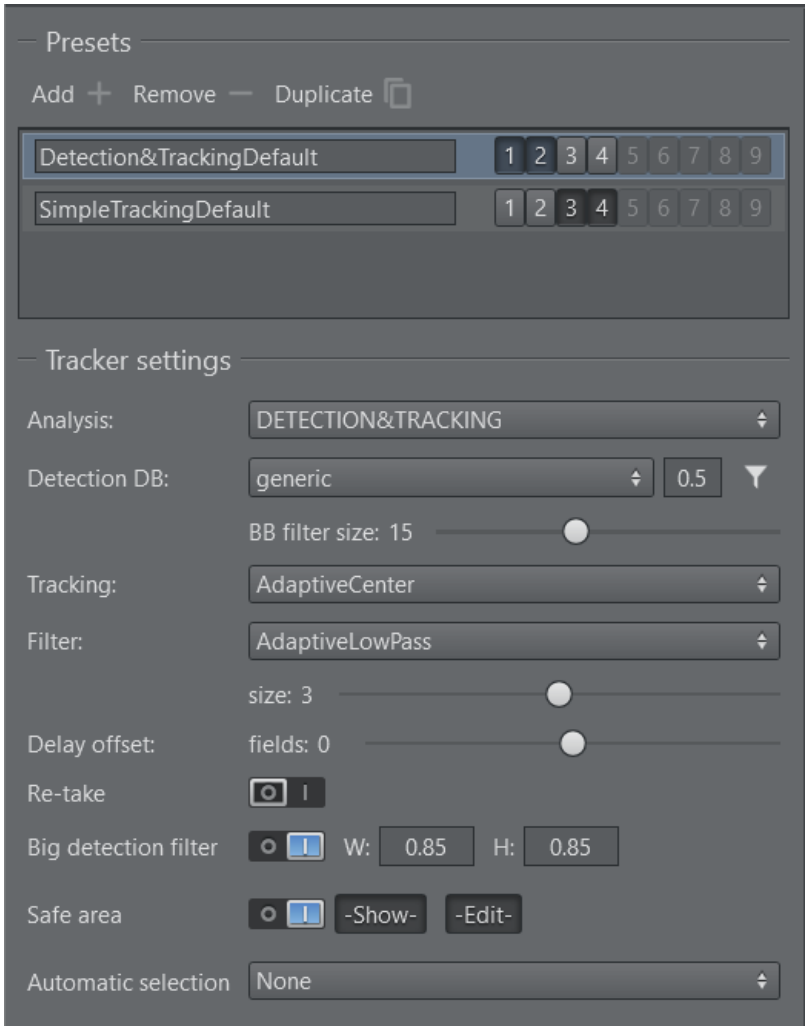
Right clicking the toggle buttons of the trackers changes the assigned color.

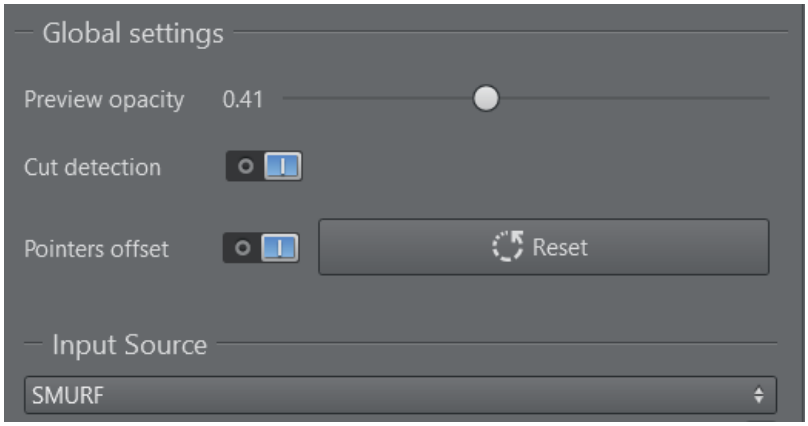
5.2 Scripting Panel



The scripting panel can be used for custom scripts that might be tailored for specific use cases. It allows easy and quick data entry and features the full power Viz Arc's Scripting capabilities. Tracking related callbacks and functions can be used within the scripting for maximum flexibility.

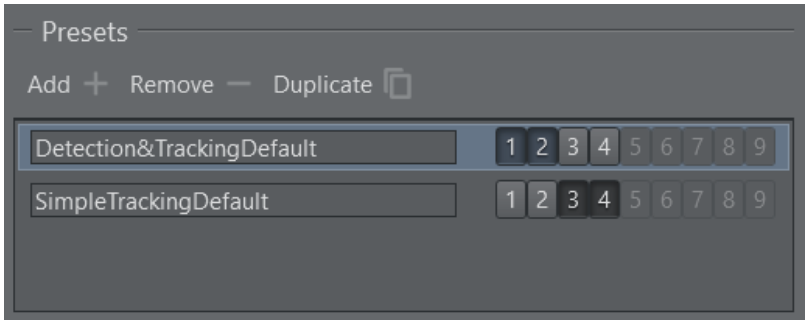
6 Settings Panel





6.1 Presets

It is possible to create multiple presets where you can select which tracking algorithm to use and which neural network to work with for the AI tracker. Each algorithm has specific settings which are exposed in the *Tracker Settings*. One or more Tracking ID(s) can be assigned to a preset. All active presets (the ones that have at least one tracking ID assigned) run altogether and the Object Tracker switches algorithms seamlessly according with the current tracking ID.



6.2 Tracker Settings

6.2.1 Analysis

Manual

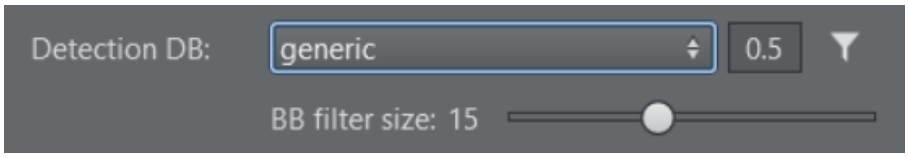
This mode allows you to manually track using the mouse pointer, touch screen or pen input.

Detection and Tracking

This option selects the AI tracker based on a neural network.

Detection DB

The network to be used can be selected under **Detection Types**.

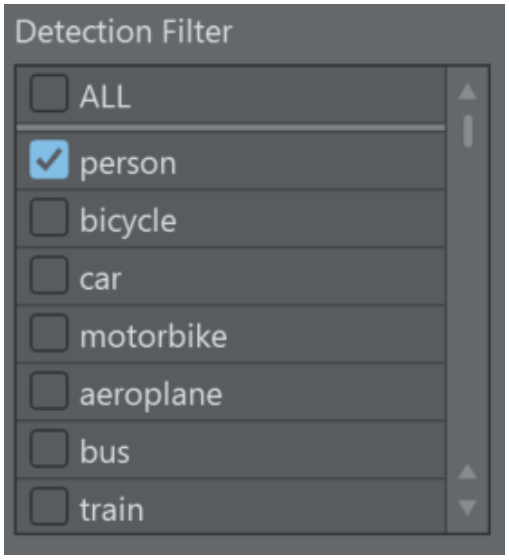


The **generic** network is always available and offers a couple of standard objects that it recognizes (for example, people, cars, etc.).

The number besides the dropdown represents a threshold in the range of `0.0` to `1.0`. It represents a factor of confidence of how well an object has been detected. The higher the value, the higher the probability the detection is correct. Object with a low confidence score can be ignored by using this threshold value. Depending on the quality of the images and the neural network, this value can be adjusted to improve the overall tracking.

The list of available objects is shown if the button **Detection Filter** is pressed. This is the list of objects that are recognized by the neural network.

Detection Filter



Select which objects of you want to detect. In most cases, you would like to select one or two kind of objects in a video stream.

BB (Bounding Box) Filter Size

The bounding boxes undergo a different filtering than the actual tracking point as it is more noisy and is subject to more extreme and sudden changes over time (for example, a person walking). You can configure a filter size for smoothing the bounding boxes for the tracking output. It is particularly useful when graphics need to be aligned to

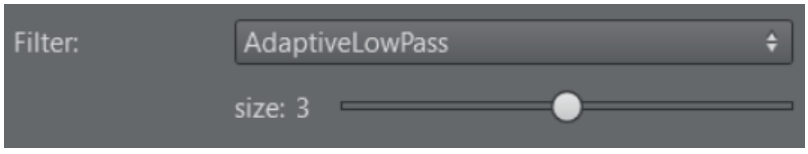
the bounding box. If you're using the *Simple Tracking*, the bounding box size slider is disable since there are no bounding boxes.

Tracking

The Tracking Types dropdown lets you choose what kind refined tracking to use inside of the detected bounding box. The button next to the drop down sends the new settings to the Object Tracker without having to use the global initialize button.

- **AdaptiveCenter:** Extracts color/luminance features around the center of the bounding box. A gravity force re-centers the tracking point toward the center of the bounding box over time to avoid drifting.
- **AdaptiveTop:** Extracts color/luminance features towards the top area of the bounding box. This is typically used when tracking persons as the arms and legs might move too much for a stable tracking, while the area of the chest and head are more stable and yield better tracking results. As for the tracker above, a gravity force re-centers the tracking point toward the center of the bounding box over time to avoid drifting.
- **MagneticCenter:** Works as *AdaptiveCenter* but when the object is not detected it uses the same algorithm of the *Simple Tracking - Adaptive* to try to follow the object; the downside is that the tracking is never lost, the operator has to manually turn off the tracking.
- **MagneticTop:** Works as *AdaptiveTop* but when the object is not detected it uses the same algorithm of the *Simple Tracking - Adaptive* to try to follow the object; the downside is that the tracking is never lost, the operator has to manually turn off the tracking.
- **TrackerCenter:** Extracts features around the center of the bounding box. A gravity force re-centers the tracking point toward the center of the bounding box over time to avoid drifting.
- **TrackerTop:** Extracts features towards the top area of the bounding box. A gravity force re-centers the tracking point toward the center of the bounding box over time to avoid drifting.
- **Simple:** Uses the center of the detected bounding box as tracked reference.

Filter



Filter Types

The filter types allow you to filter the tracked point over time. Several are available. The button next to the drop down sends the new settings to the Object Tracker without having to use the global initialize button.

- **AdaptiveLowPass:** Minimizes jitter and lag using a low pass filter.
- **MovingAverage:** Calculates the average of the last points.
- **ExponentialMovingAverage:** Gives more weight to the most recent points. Similar to *MovingAverage*.

Size

Increasing the size of the filter helps to smooth noisy results.

Warning: Be very careful when using filters. In most cases, they lead to undesired lags especially for rapid and sudden changes in direction of the tracked object. The larger the size of the filter, the larger is the lag. However, the filters might be very beneficial on smooth and slow movements of objects.

Re-take

When enabled, if a tracked object is lost and later detected again with the same ID, it automatically resumes tracking. However, if the safe area is enabled, the object is only re-tracked once it is inside the defined safe area.

Big Detection Filter

When enabled, it filters out any detections whose size exceeds the specified width or height limits. This can be useful for eliminating certain false positives. The threshold values are within the range of `0.0` to `1.0`.

Safe Area

When enabled, if a tracked object exits the boundaries of the rectangle, it is automatically removed. Objects can still be tracked outside the safe area, but once they enter it, the safe area rules apply.

You can adjust the size of the safe area by enabling the **Edit** button and dragging the edges of the rectangle.

You can show or hide the safe area from the preview by clicking the **Show** button.

Automatic Selection

There are three different algorithms to choose from:

- **None:** Disables automatic detection.
- **Score:** Selects the object with the highest score.
- **Center:** Selects the object closest to the center of the image.

Currently, the algorithm selects only one object and uses the first pointer configured in the preset. For example, if pointers 2 and 3 are enabled for analysis, the automatic selection uses pointer 2. If the safe area is enabled, only the detection inside the rectangle are considered. If the safe area is enabled, only detections within the rectangle are considered.

An example of a bounding box of a detected *person* object.

Simple Tracking

Tracking Types

This option tracks objects without the aid of a neural network: it uses the same algorithm that are used for the refined tracking in the *Detection and Tracking*.

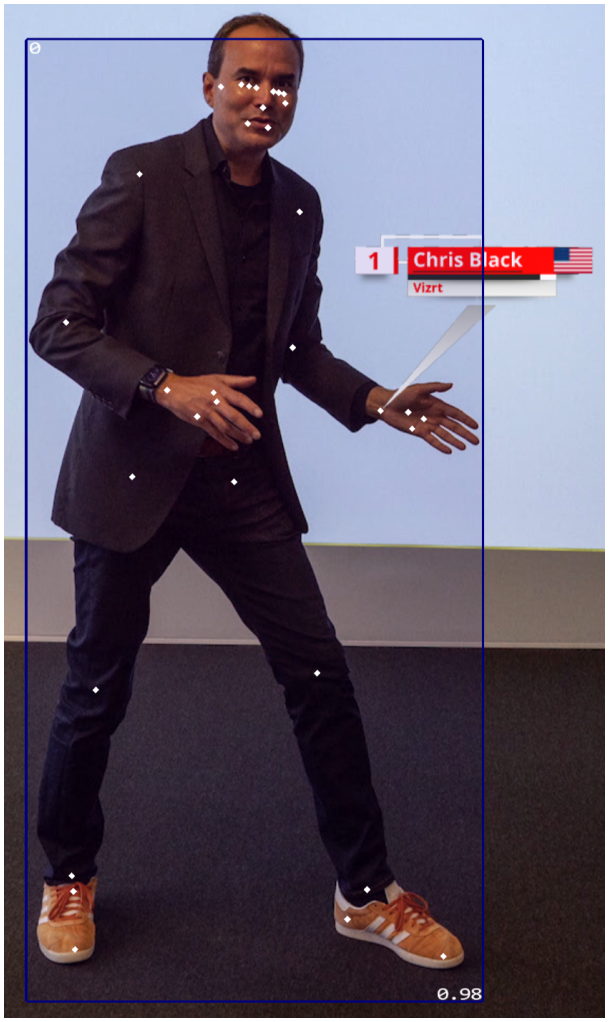
- **Adaptive:** Extracts color/luminance features around the clicked point.
- **KCF:** Extracts generic features around the clicked item.

Filters

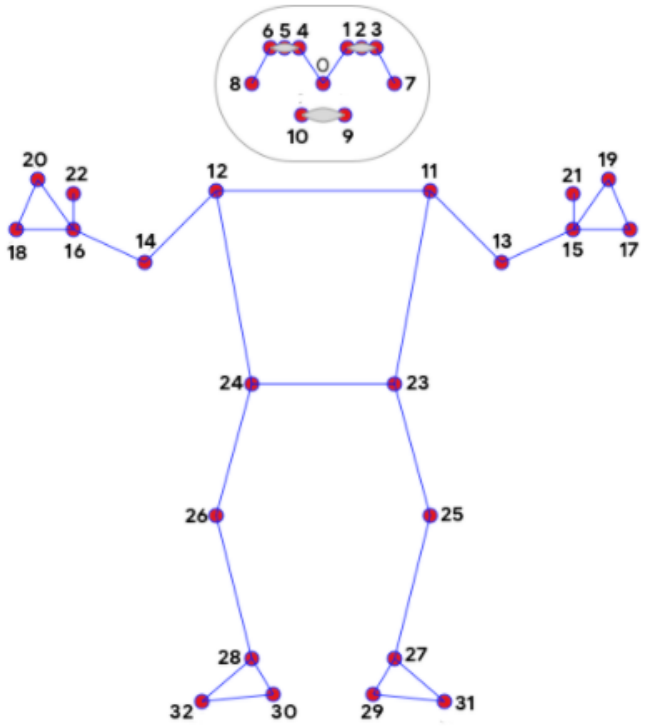
Same as the Filter in Detection and Tracking.

2D Pose Tracking

This mode allows you to track the pose of one person.



This is the map of the points sent to Viz Engine(s):



0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
20. right_index
21. left_thumb
22. right_thumb
23. left_hip
24. right_hip
25. left_knee
26. right_knee
27. left_ankle
28. right_ankle
29. left_heel
30. right_heel
31. left_foot_index
32. right_foot_index

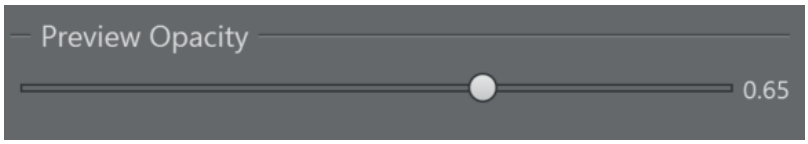
6.2.2 Delay Offset

The Object Tracker delays the results to match the video images with the tracking information; this slider increases (max +10) or decreases (min -10) the delay, in fields, applied. This can be useful to compensate the lag due to aggressive filtering.

Apply Changes: Please note that changes made in the tracker panel are not always applied immediately. A yellow triangle indicates when the parameters displayed in the panel differ from those currently used by the running algorithms. In this case, the analysis must be reinitialized to apply all parameter updates. A tooltip will guide you through the required action.

6.3 Global Settings

6.3.1 Preview Opacity

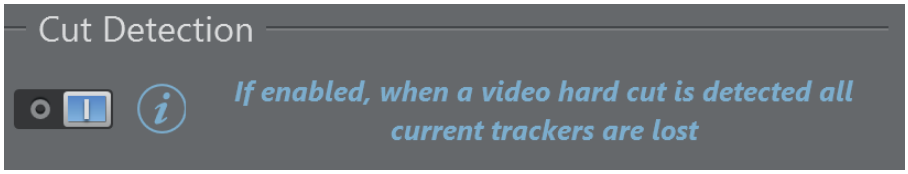


The preview output that has been configured in Viz Arc can be rendered on top of the NDI stream coming from the Object Tracker. This allows the operator to preview the graphics on screen. The opacity of this preview can be adjusted here.

The preview is intended to verify the editorial graphics content and not the accuracy of the tracking.

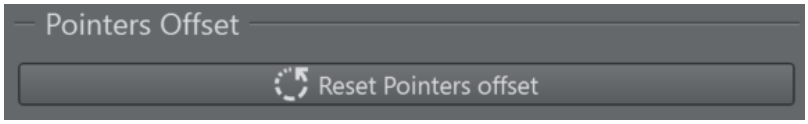
Information: For performance reasons, the composed on-screen preview might not look the same as on the actual program output. Make sure the fill channel of the preview is black where it is supposed to be transparent. The timing between the underlying NDI stream and preview is not guaranteed to be correct. The tracking and the preview graphics might not match.

6.3.2 Cut Detection



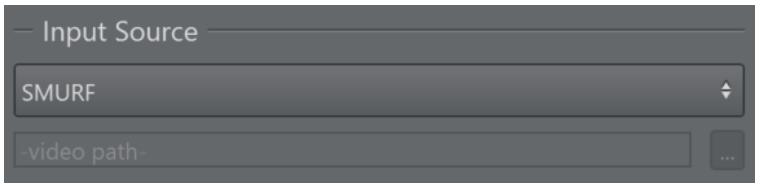
If enabled, when a video hard cut is detected all current trackers are lost.

6.3.3 Pointers Offset



It resets the pointers offset of each tracking input.

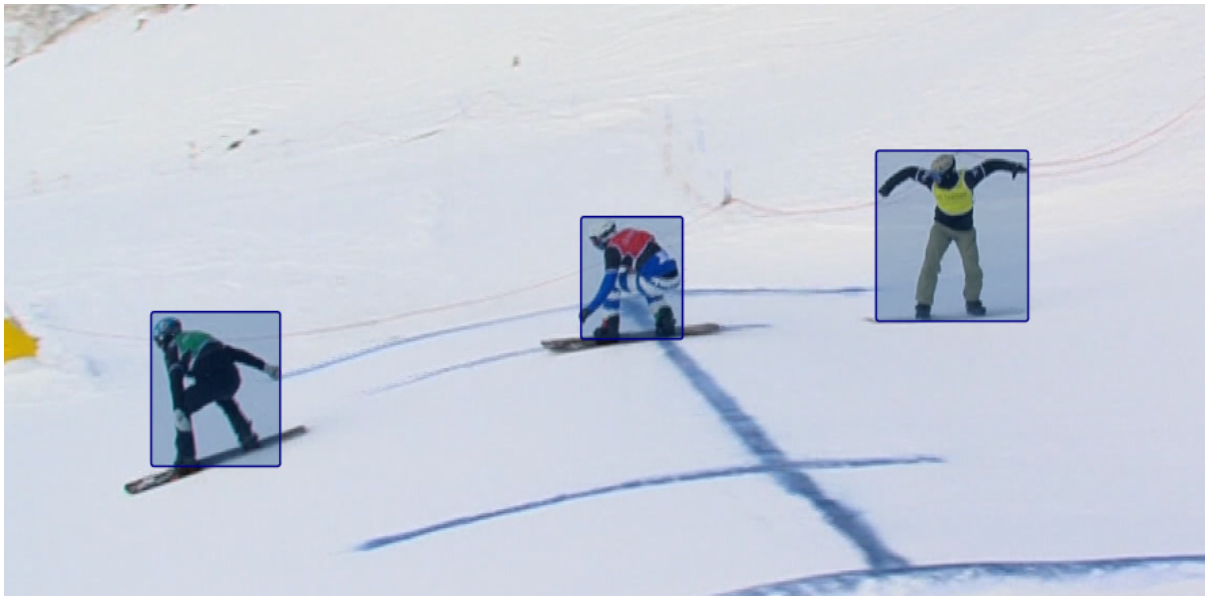
6.3.4 Input Source

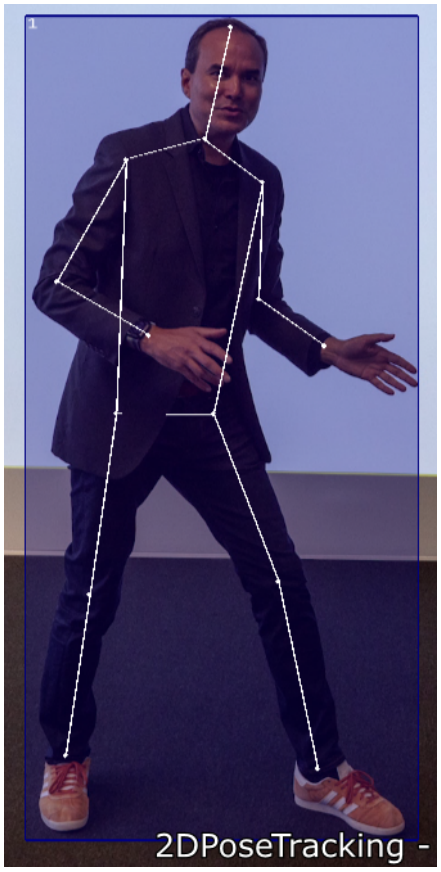


Select **SMURF** to select the Engine's input running where the Object Tracker has been installed. When installing Viz Arc locally, you are also able to select a file. This workflow is intended for testing only as it is not guaranteed to run in real-time.

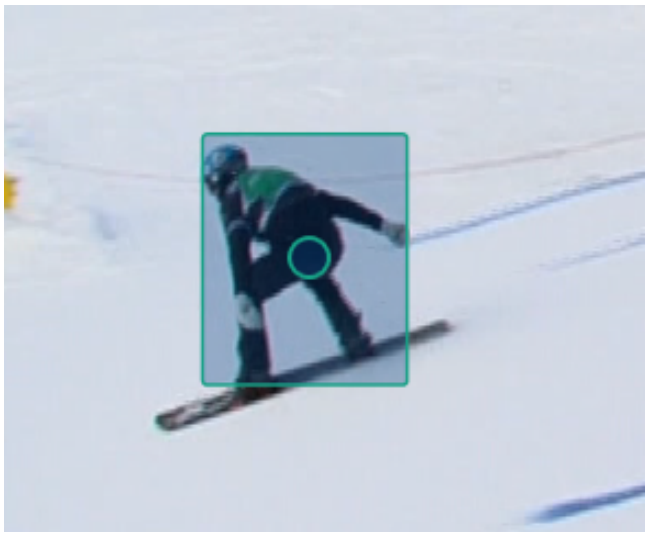
7 Operating the Object Tracker

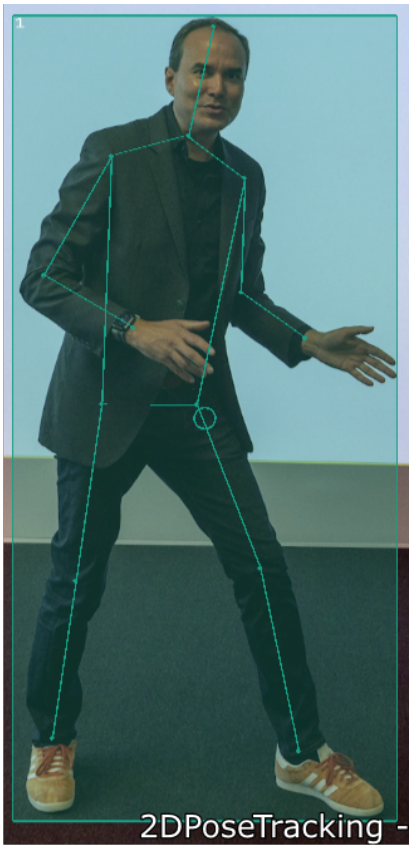
7.1 Detection and Tracking and 2D Pose Tracking





Select an active tracker and use the **left mouse button** and click on any of the blue bounding boxes around the tracked objects. Clicks don't have to be within the bounding box, the bounding box closest to the mouse click is selected.

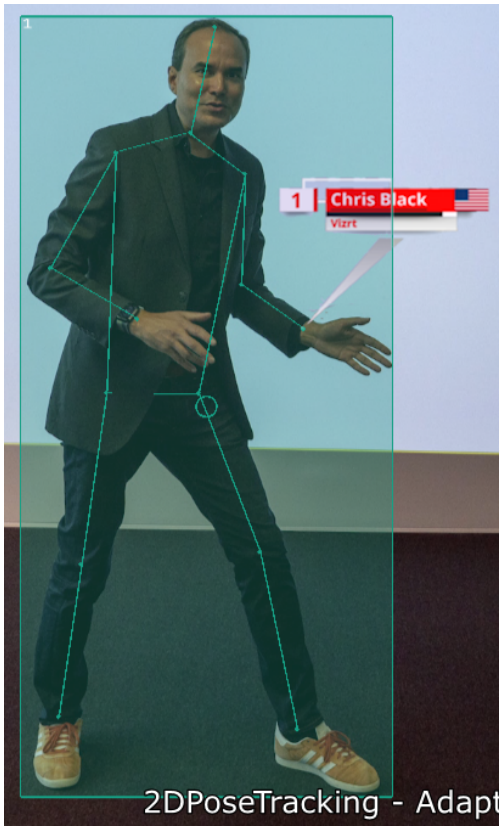




Once selected, the bounding box changes to the color of the tracker and a circle appears in the center of the bounding box. The center of the circle is the actual point being tracked. Depending on how the **In Action** has been configured, the action is executed automatically or it needs to be triggered manually either through the **SPACEBAR** or **Take** button. It always executes on the preview cannel.

Right click on or close to the bounding box to put the graphics Off Air. Use the **BACKSPACE** or the **Take Out** button to take all graphics Off Air.

When available, select the next available tracker either through the **TAB** shortcut or by selecting the tracker from the top **Tracked Object** bar.

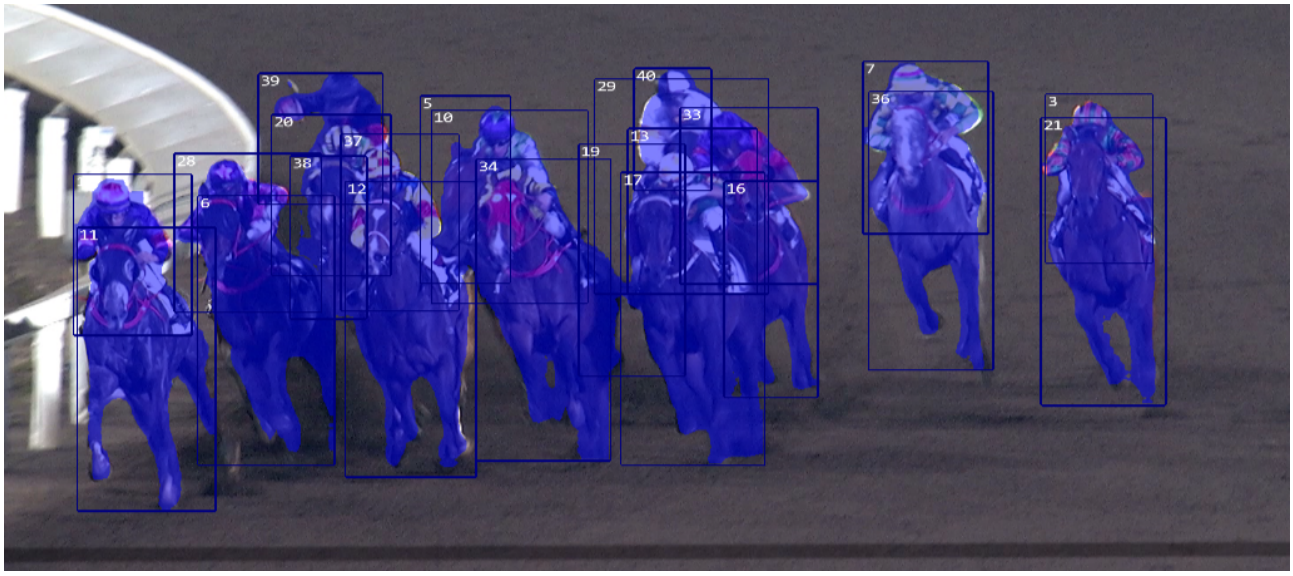


7.2 Simple Tracking

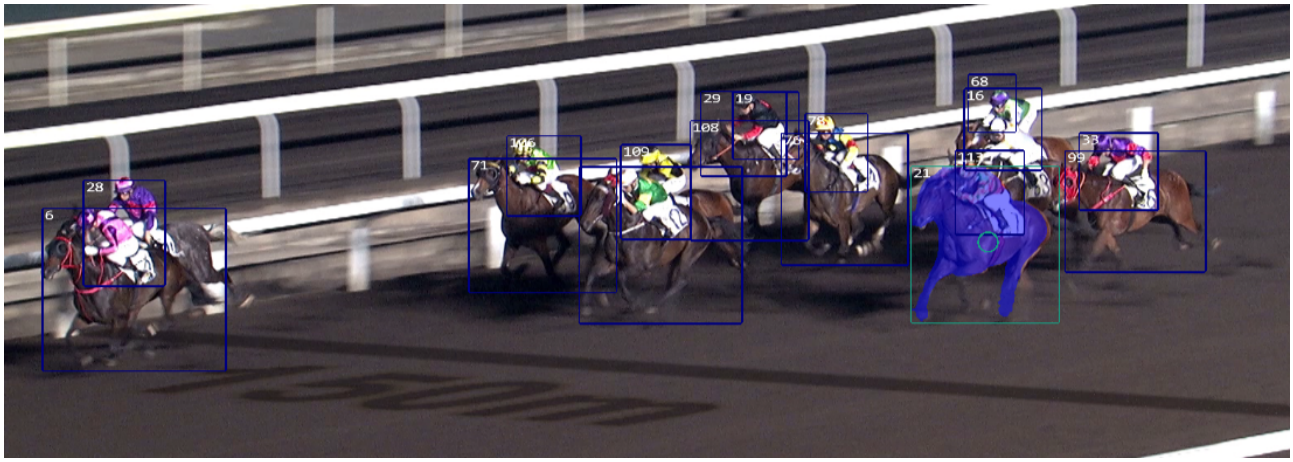
To use it, click on the point you want to follow, the algorithm attempts to go after it. Obstructions are the main reason it gets lost.

7.3 Detection and Segmentation

When there is no object tracked/selected a mask with all the object detected is created.



If one or more objects are selected, the mask is generated using only the objects tracked.



7.4 Manual Tracking

It is possible to work with manual tracking, if there are cases where both *Detection and Tracking* and *Simple Tracking* fail. To use it, just hold down the left mouse button to start tracking and release it to lose tracking.

7.5 Offsets

If you want to apply an offset to displace the pointer, the steps are:

- First, you have to enable the option in the config menu of the Tracking Object.
- When you click on the frame, you have to keep the mouse down (the image freezes).
- Move the mouse around until you are satisfied with the offset.

- Release the mouse to apply the offset.
    - If the object is still visible, you'll see the pointer with the displacement applied.
    - If the object is no longer visible, you'll have to click on a new object to see the result.