Nuke 11 Tracking

Introduction

Tracking refers to the concept of locking onto one or more <u>features</u> in an image sequence and following them as that image sequence progresses. Typical use-cases for tracking include…
- camera stabilization
- replacing a moving region in a scene (e.g. a screen for a phone or watch)
- mapping out the movement of an object in the scene

Features

The term <u>feature</u> refers to any static / semi-static point in the shot. The user typically starts out by picking these points and setting a few parameters. The tracking algorithm will take those points and parameters and try it's best to follow the point as the image sequence progresses.

> **NOTE**: Even with algorithmic tracking, the user may need to tweak the track manually. The track may get offset or lost due to quick movements that cause the portion being tracked to blur. These frames must be manually tracked by the artist.

What makes a good feature for algorithmic tracking? The feature should …
- be identifiable and static throughout the frames
- be well lit and remain so throughout the frames

- not drastically change between frames
- not enter a heavy shadow between frames
- have a high contrast difference between its foreground and background

In the following example, each of the cats 2 eyes are being as a feature. Each eye is easily identifiable and doesn't drastically change, and there's a good contrast between the iris (cream coloured) and pupils (black)...
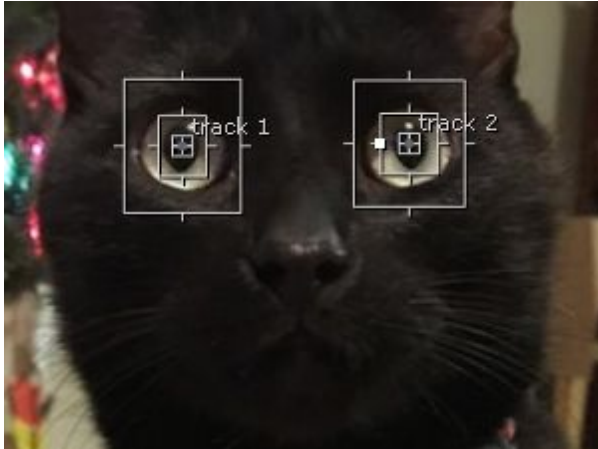
Transformations

The number of features defines what type of transformations can be tracked. If you're tracking only 1 feature, you're only going to get 2D position (translation) information.

If you're tracking 2 (or more) features, you can get 2D scale and rotation information as well. What essentially happens is that the 2 features form the endpoints of a line. The line endpoints are compared to the line endpoints from a previous/reference frame to determine how much rotation/scale to add (the line can twist or grow or shrink).
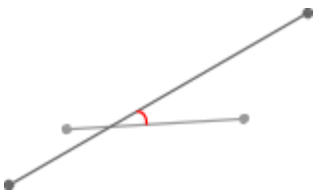
You can also use multiple tracks to get better information. For example, you can use multiple tracks for just translation. The result of the translation will be the average movement between the them.

> **NOTE**: Nuke recommends a 3-point track if you're planning on dealing with rotation and scale as well? But 2-point tracks will work as well.
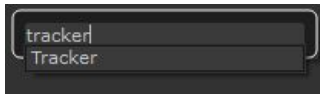
Tracker Node

In Nuke, tracking is done using the <u>Tracker</u> node. Image data is fed into the Tracker node and the artist defines the features to track in the viewer. These tracked features can then be linked to by other nodes for use down the line (the tracker node also provides some common tracking functionality directly within the node).
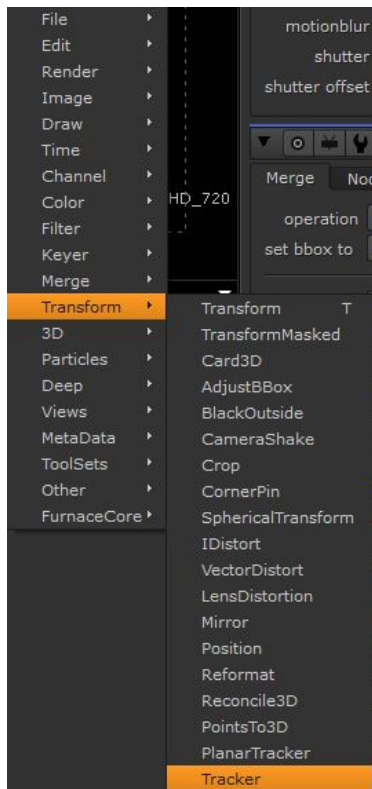

Adding Node

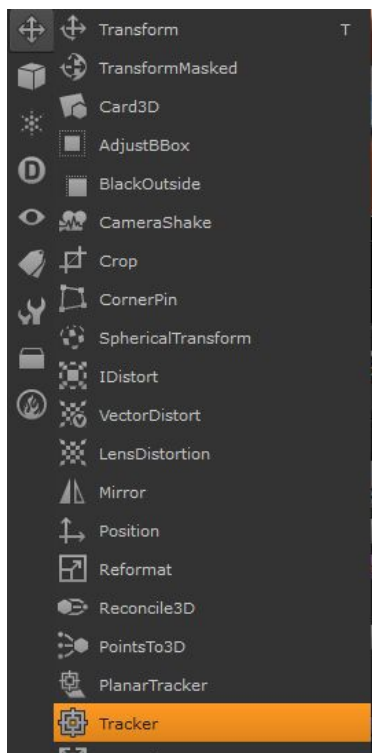To add a Tracker node, you can use any of 3 basic methods described in the main Nuke document…

- Tab menu → hit tab in the graph and type in Tracker…

● Context menu → right-click in the graph and goto Transform → Tracker…

● Toolbar → click the cross-hatched arrows and select Roto…

If you already have a node selected when you add the Roto node, it'll get added to the output of the selected node. If the selected node already has an output, it'll get added between the nodes.


Tracking Features

To add track a feature in a tracker node, open up the properties, go to the Tracker tab, and hit the Add Track button…
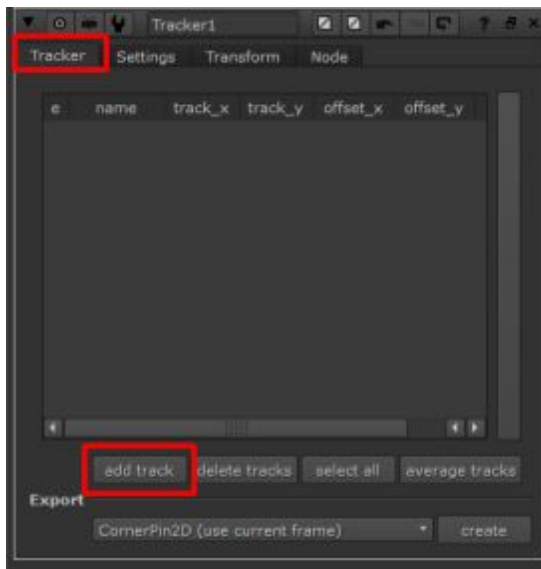
> **NOTE**: Forgot how to open the propertie for a node? Double-click it in the node graph. Remember that you can have the properties for multiple nodes open at once. If you have the properties for 2+ Track nodes open at once, things will get confusing because the tracking markers for all nodes will show up in the viewer. It's best to close down the properties of any other tracker nodes.

Once you've added the tracker, the marker for that tracker will show up in the middle of your viewer and in your node's properties...
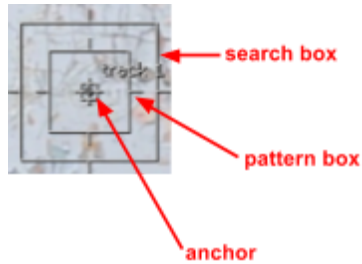
The marker is what defines, identifies, and follows the feature...
- anchor → part of the feature to fixate on
- pattern box → area encompassing the feature (what to search for)
- search box → area to search for where feature has moved to when moving frames

Scrub to your reference frame and move the marker by its anchor to the feature you want to track. Once placed, you can resize the pattern box by dragging it to encompass the feature you're tracking. Same thing with the search box -- you'll want it large enough so that as the feature moves between frames, it's still in the search box area.

> **NOTE**: You can ONLY MOVE THE MARKER USING THE ANCHOR. Mouse manipulation on the pattern/search box just resizes those boxes around the anchor.

Creating Tracks

There are 2 types of tracking: auto tracking and keyframe tracking.

Auto Tracking

> **NOTE**: After reading this section, check out the improving tracks section. It contains some extra notes on how to get better auto tracking.

In many simple cases, you can get away with auto tracking. Auto tracking is where Nuke will use the parameters you defined (search box / pattern box / etc..) to try to automatically identify and follow the feature between frames.

To do this, make sure that the marker is correctly placed/sized on the feature, then go to the toolbar in the viewer and select either the track to end or track to start buttons…
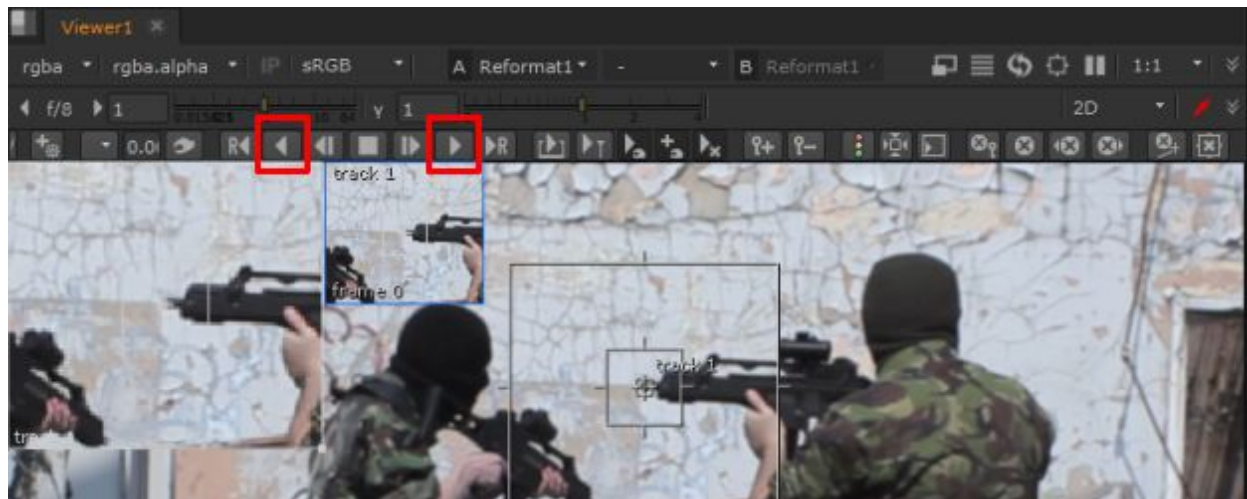
> **NOTE**: Don't see this toolbar in the viewer? Make sure the properties for your tracker node are open and the track is selected in the properties.

If you click the …
- forward button, it'll track the feature while moving frames forward.
- backward button, it'll track the feature while moving frames backward.

Once one of these buttons gets clicked, the autotrack will start tracking until it either hits the last frame or gets to a point where it can no longer identify the feature.

> **NOTE**: If you set your marker at a frame > 0, you'll likely want to use both the forward and backward buttons. Start from the frame you set the marker at and hit forward button, then go back to that frame and hit the backward button.

> **NOTE**: If you click the R buttons to the side of the forward/backward buttons, it'll let you specify a maximum number of frame to autotrack instead of tracking until the end.

In many cases, autotrack will continue tracking but track the wrong thing because…
- the object got obscured
- the search box wasn't big enough
- the pattern didn't stand out enough
- etc…

In the following example, the gun barrel is tracked properly into the 2nd frame, but by the 3rd frame it gets obscured by the soldier's body. The autotrack tries its best to identify the feature, but since the feature isn't there anymore it locks onto what it thinks is the next closest thing…

In the tracker toolbar, there's a button that looks like a traffic light. If you enable it, the points of your track will turn red/yellow/green depending on how bad/good the identification of the feature was. If we turn it on for the above example, we see that the 3rd frame is a solid red, which means that it's very unsure about the track…

To fix this, we need to use keyframe tracking (discussed below), but essentially everything past the 2nd frame is a bad and needs to be discarded. To do this, navigate to the last good frame then go to the toolbar and hit clear forward button…

NOTE: The button to the right is the clear backwards button. Use this if you're autotracking backwards instead of forwards.

Keyframe Tracking

Keyframe tracking is where you manually track the feature between frames. It's a bit tedious to do if you're doing it for every frame, but the typical workflow is to track using auto track until it screws up, use keyframe tracking to get it back on the correct path, then go back to using autotrack.

To set a tracking keyframe, navigate to the frame and just move the tracking marker. As soon as you release the mouse button, a tracking keyframe gets set…
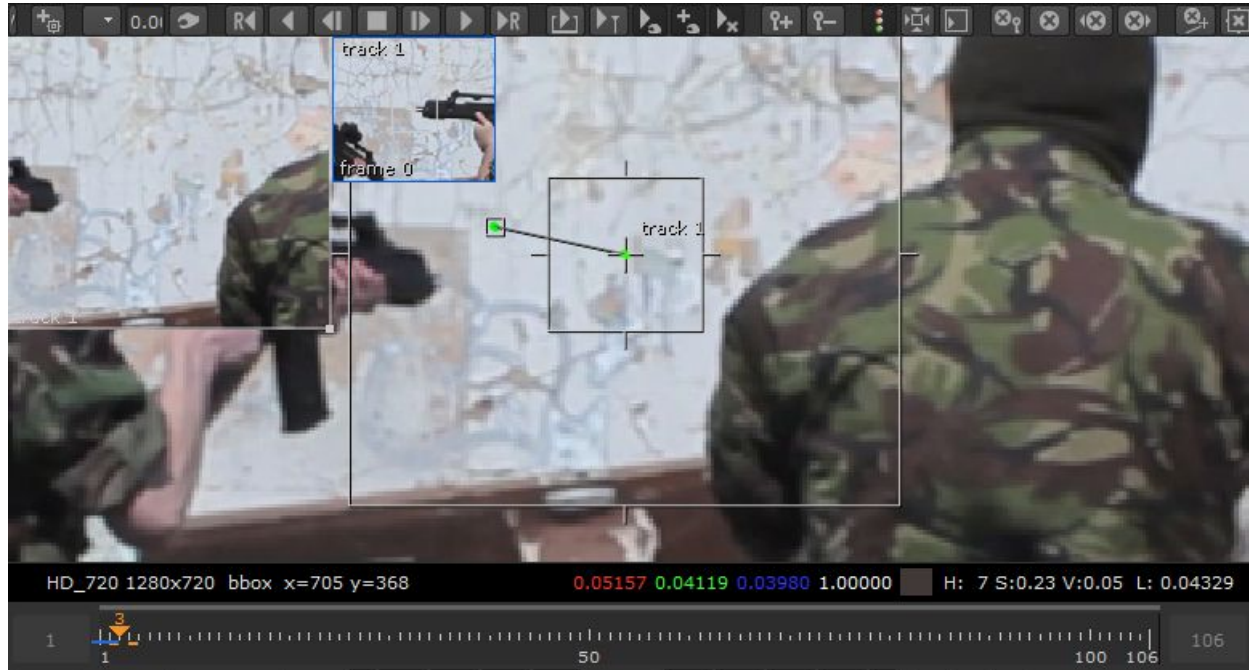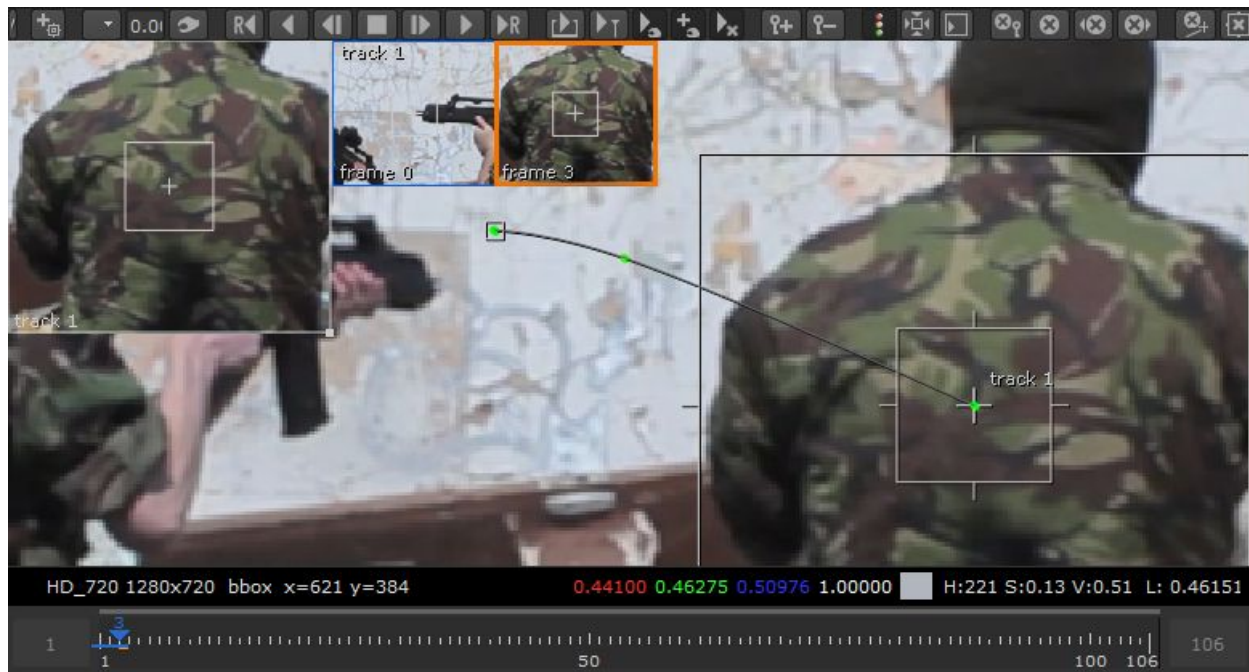
NOTE: Notice how a new thumbnail shows up at the top of the viewer when you manually set a keyframe marker. That's how you know it's a keyframe.

Another way to set a tracking keyframe is to have autotrack calculate where it thinks the feature will be in the next frame, and then manually adjust it. You can do this by using either the track next or the track prev toolbar buttons…
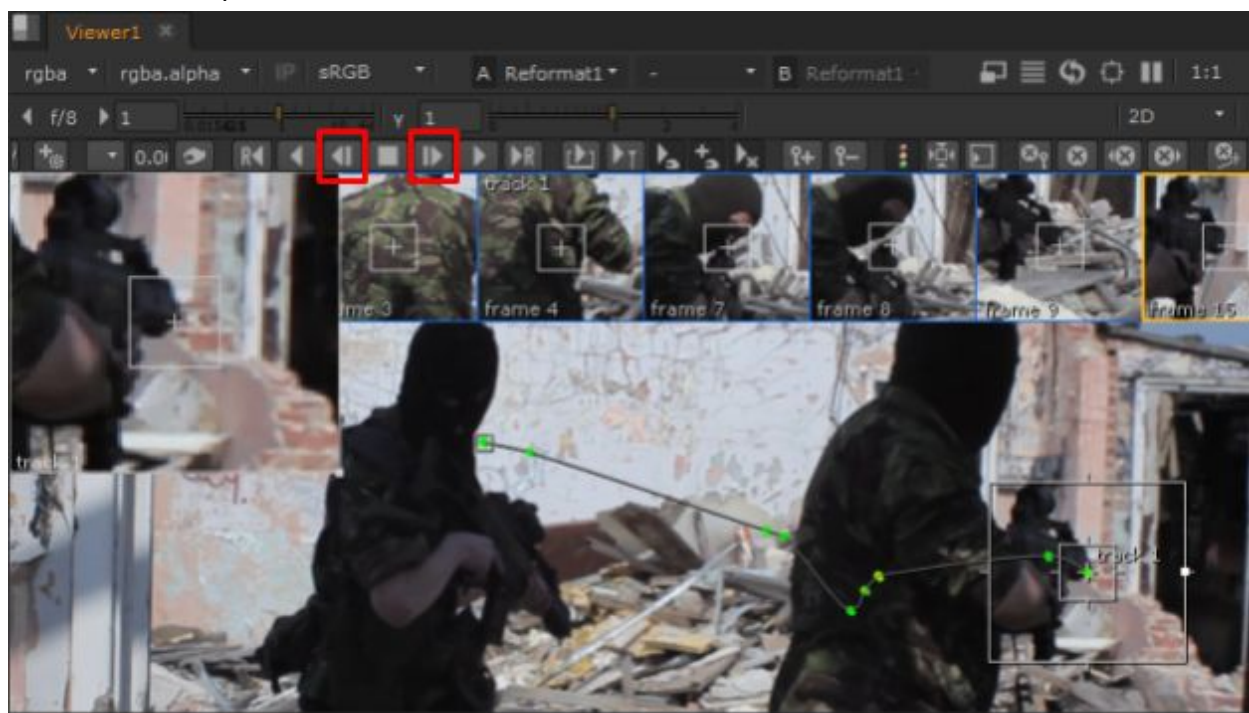
NOTE: Don't see this toolbar in the viewer? Make sure the properties for your tracker node are open and the track is selected in the properties.

NOTE: Notice all the thumbnails up top -- these are for each frame that's using keyframe tracking. Even though we're using the track next/track prev buttons, as soon as we move the marker the track for that frame will get converted from an auto track to keyframe track.

Offsetting Tracks

If the feature you're tracking gets obscured or goes off-screen, you can temporarily offset your marker onto another feature until it comes back into view. The feature you swap to will act as an offset for the main feature. That means that the movement of this temporary feature will be controlling the original track -- the track point will get offset by the temporary feature's movement.

For example, imagine that we're tracking the following black wall stain…
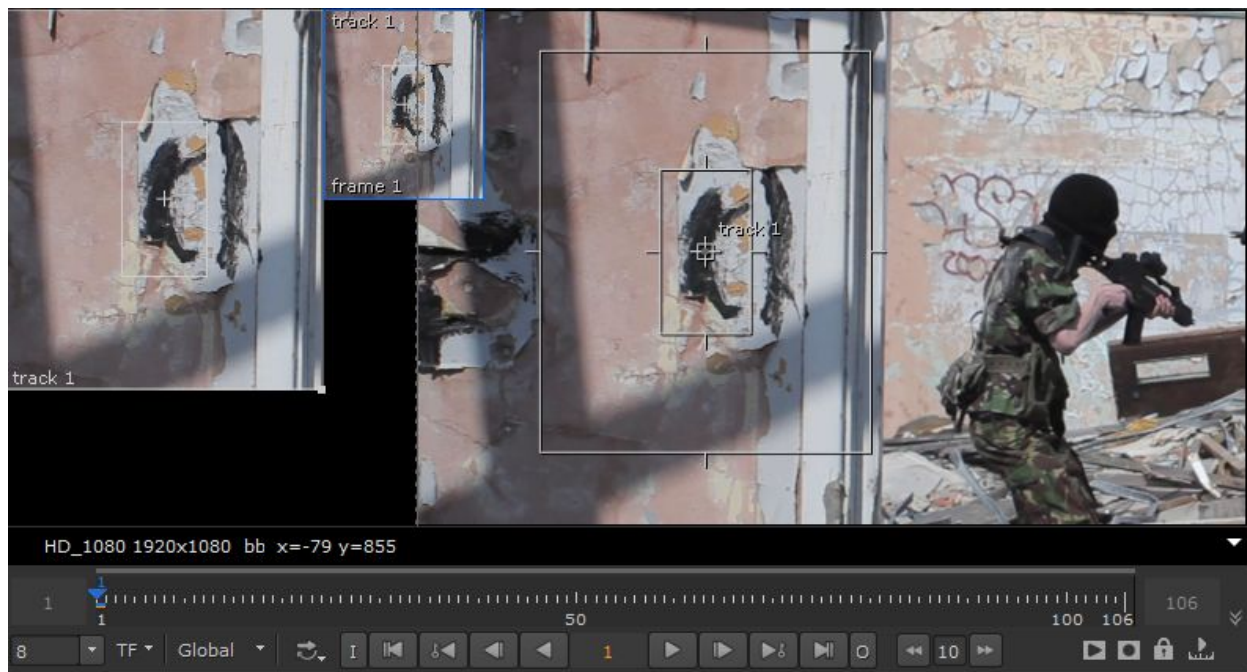


By the 29th frame, this feature will be obscured by the soldier and won't be trackable anymore…
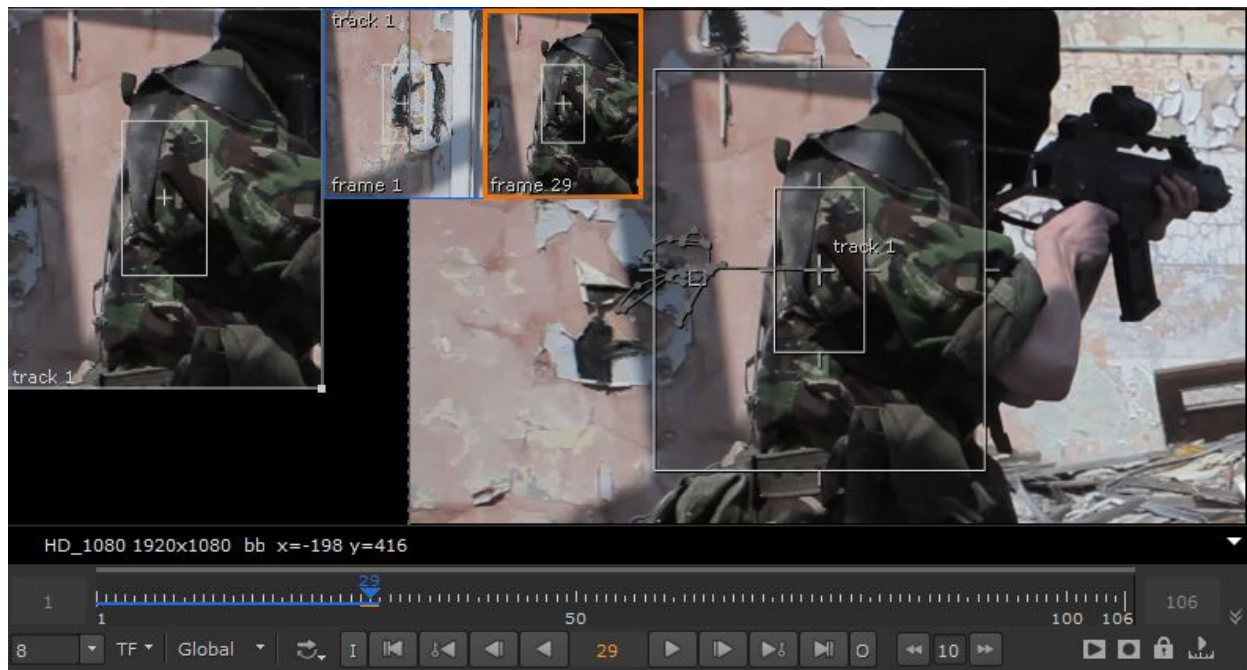
If this happens, we can temporarily move our marker to another feature (preferably on the same rigid body) to continue tracking. We do this on the frame IMMEDIATELY BEFORE the frame where the feature gets obscured by Ctrl+LMB click-dragging the marker's anchor to the new feature. That new feature will then be used to offset the original point being tracked.

In the example above, we'll Ctrl+LMB click-drag the anchor on frame 28 (just before our original feature gets obscured) to the blotches just to the left of our original blotch…
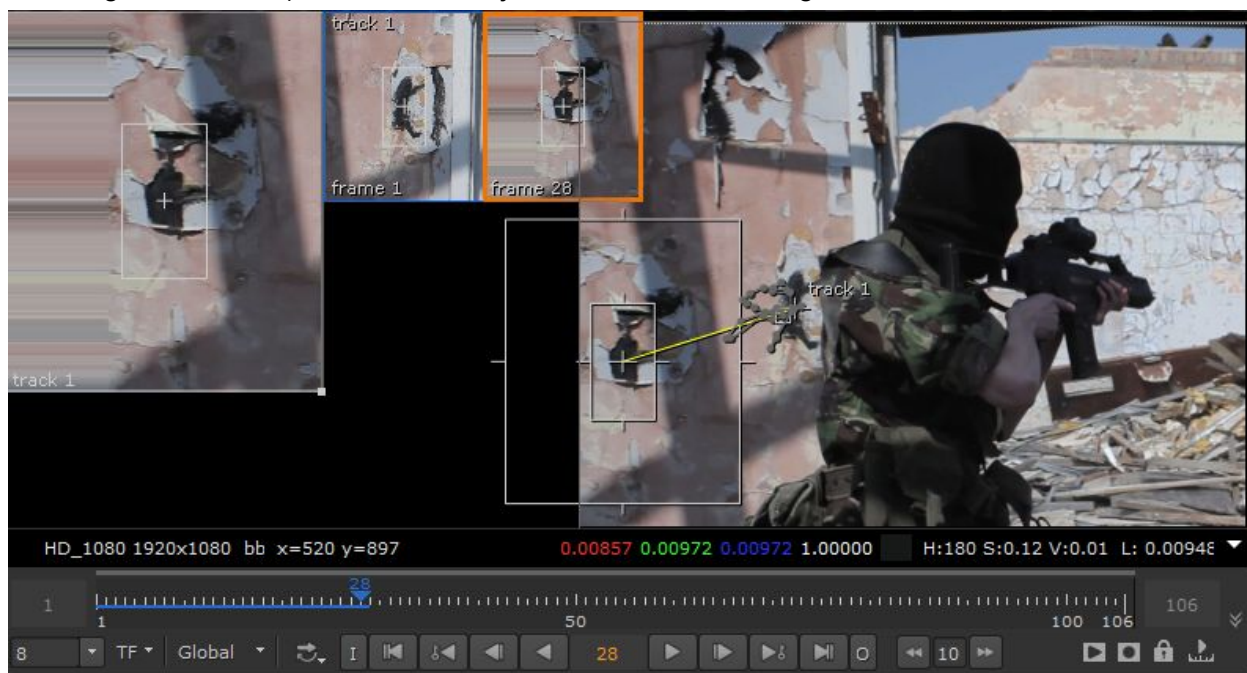
NOTE: The yellow line in the screenshot above denotes that this new feature's track will be used to offset the original track position moving forward. As this new feature moves, the movement offsets will be applied to the original track.

NOTE: Don't forget to hit the clear forward toolbar button when you go to the frame immediately before where the obscuring happens. Remember that it clears the track of everything after the frame you're on -- that data is no longer good because the feature was obstructed. See previous sections to find out which button is the clear forward/backward (search this doc using Ctrl+F).

We can move this temporary anchor as many times as we need to before putting it back onto the original feature being tracked. Just follow the same process: on the frame IMMEDIATELY BEFORE it gets obscured, Ctrl+LMB click-drag the marker's anchor to a new feature and continue the autotrack.

Once the feature is visible again, you can click the clear offset button in the toolbar and move the marker's anchor back to the original feature. If you didn't mess anything up, when you hit the clear offset button the track should come back onto (or very close) the original feature...
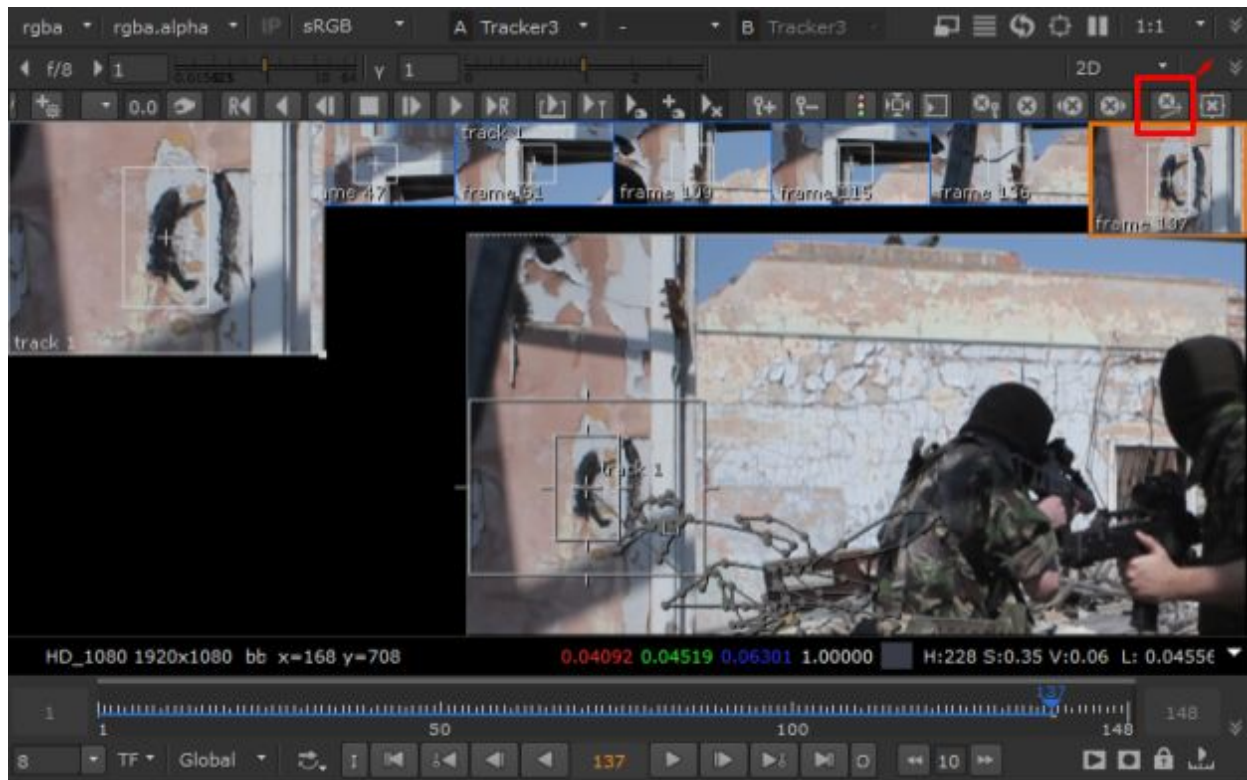
Rotation/Scale Tracks

As already mentioned in the introduction, tracking only 1 feature will only give you translation (position) information. Tracking more than 1 feature will allow you to track rotation and scale as well.

To define which track gets used for what, you can set the T R S checkboxes on each track…
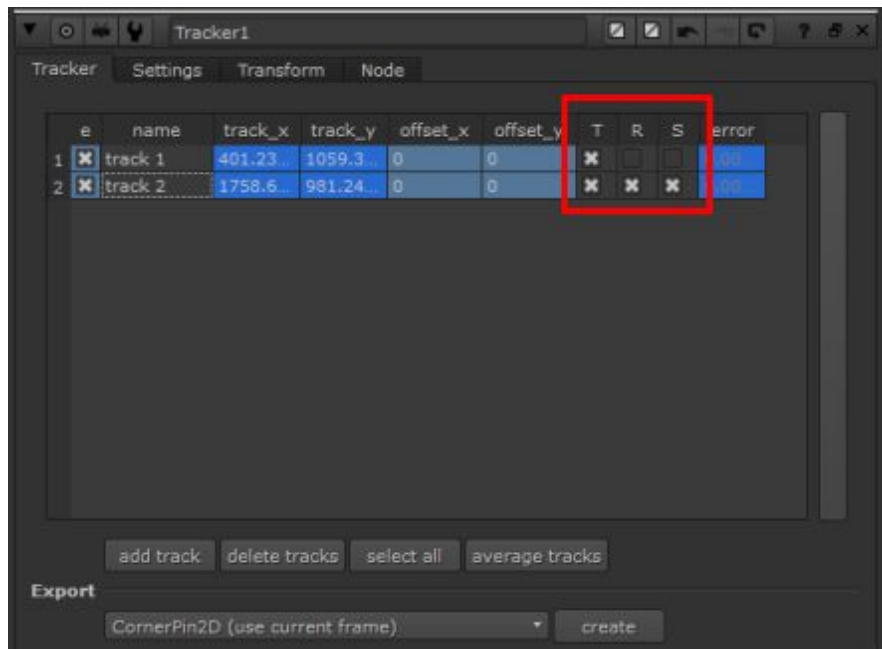
The meanings of T, R, and S should be obvious…
- T → track used for calculating translation (position)
- R → track used for calculating rotation
- S → track used for calculating scale

In the above example, multiple tracks are assigned to T. All that means is that translation (position) from both tracks are combined using averaging.

Also, notice that R and S is only set on the second track. For rotation and scale information you need to have at least 2 tracks. If you have…
- only 1 track, setting R/S on it does nothing.
- only 2 tracks, setting R/S on at least one of the tracks will give you rotation/scale.
- more than 2 tracks, setting R/S on multiple tracks will give you rotation/scale by averaging the results from each track.

NOTE: I'm not 100% sure on any of this. None of it is clearly documented, but when you try it out and go to the transformation tab, it looks like the transformation crosshairs support what's stated above.

Improving Tracks

There are some settings you can tweak to improve your feature tracking.

Pre-track filters

For autotracking, you may be able to get better results by fiddling with the options under the settings panel of the tracker node's properties…
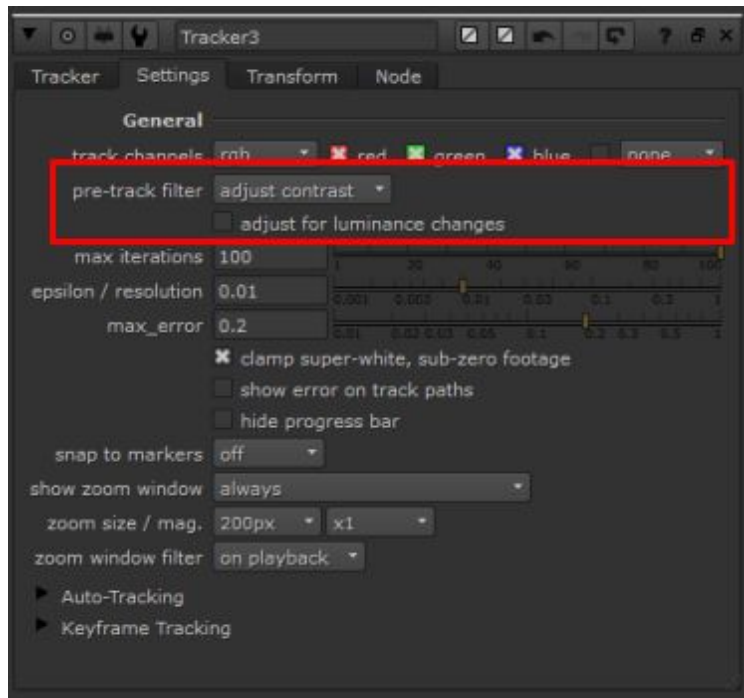
The main options here are...
- pre-track filter → This is a image filter applied to the area where the tracking is happening. The goal is to make it easier for the autotracking algorithm to follow the feature. The filter can be one of 3 values:
  - none -- no filter
  - adjust contrast -- modifies the contrast such that it becomes easier to track (this is the default). Remember that the lesson said that features that highly contrast are good for autotracking (see intro section for more info).
  - median -- attempts to denoise such that it becomes easier to track. This is only useful if your image has noise.
- adjust for luminance changes → Remember that the lesson said that features that enter in and out of shadows may not be good for autotracking (see intro section for more info). Apparently this option is to help with that. From the Nuke docs…

When enabled, Tracker does some extra pre-filtering to compensate for changes in brightness. This option slows the tracking process and can reduce the accuracy of tracks, so only enable this control if there are known changes in brightness.

Smoothing

Smoothing can be used when you have jittery tracks.

According to the lesson, some types of shots are known for having jittery/noisey tracks. The example that was given was a shot taken with a dolly. Even though the dolly is keeping the camera fixed and moving it in a straight line, it often travels over a floor that isn't a perfect plane. Even something as benign as having the dolly travel over carpet fibers causes slight jitters in the shot.

Nuke gives you the option to smooth out the transformation (rotation/scale/translate) of the track by averaging out the n frames together. To do this, update smooth values under the transformation panel of the tracker node's properties…
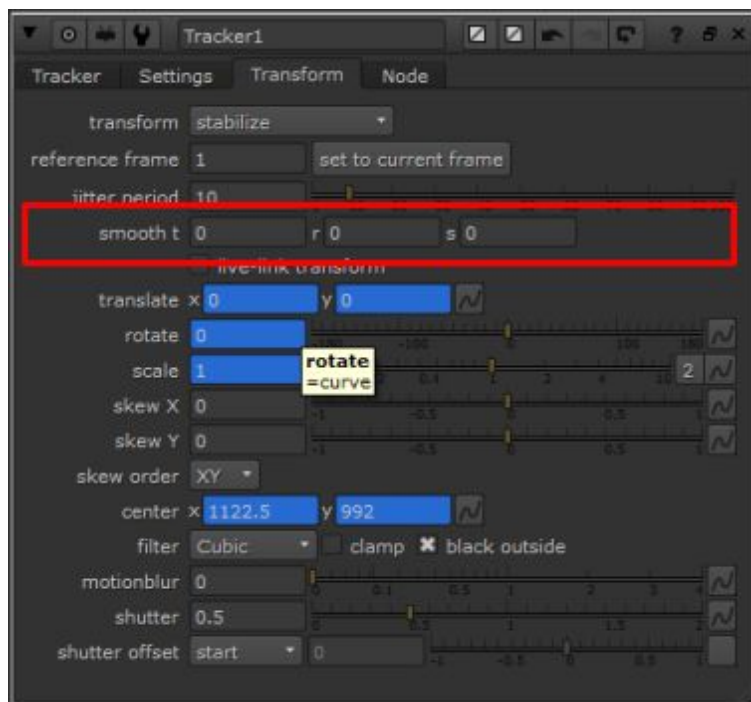
Transform Output

Once you've set up the tracks for your tracker node, you can choose what the tracker node does with that information by going to the Transformation tab…
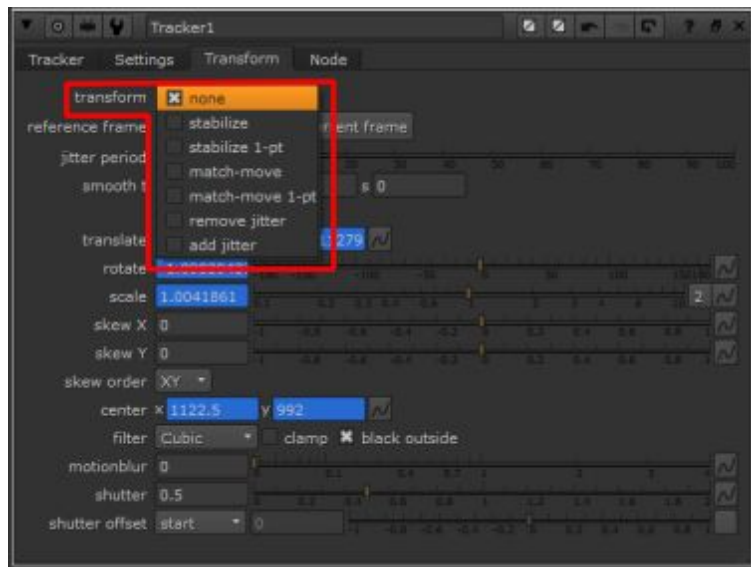
The operation performed is selected under the transform dropdown...
- none → does nothing.
- stabilize → transforms such that the points stay inplace (camera stabilization).
- match-move → transforms based on the movement (so another image can follow along).

> **NOTE**: I don't know about add/remove jitter. Use the 1-pt variants if you aren't tracking translation and scale information (you only have 1 tracker).

Another option to be aware of here is reference frame (the next one after transform). According to the Nuke docs, this is the reference frame from which the calculations for the track are done? So the rotation/scale is always calculated from this point?

> When transform is set to stabilize or match-move, sets the frame in the input sequence to use as the reference or identity frame.

Linked Output

If you want to use the final translation/rotation/scale output of your tracker node in some other node, you can link it. The transform tab in the tracker node properties will contain the computed values (they'll be highlighted in blue meaning they're animated/keyframed fields)...
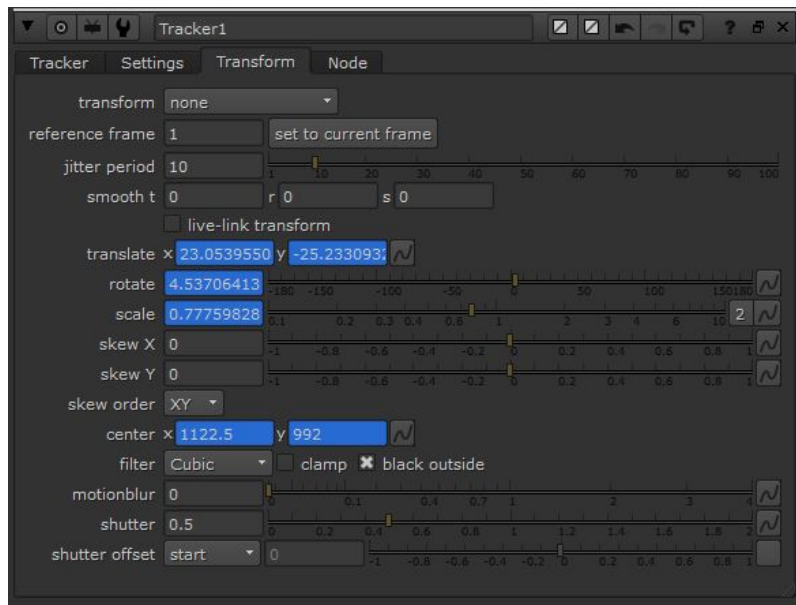
In addition, you can use transformation values from the individual trackers inside the tracker node. You can do this by going to the property which you want to set, clicking the squiggly line button next to it, and choosing the tracker node and tracker to link to…
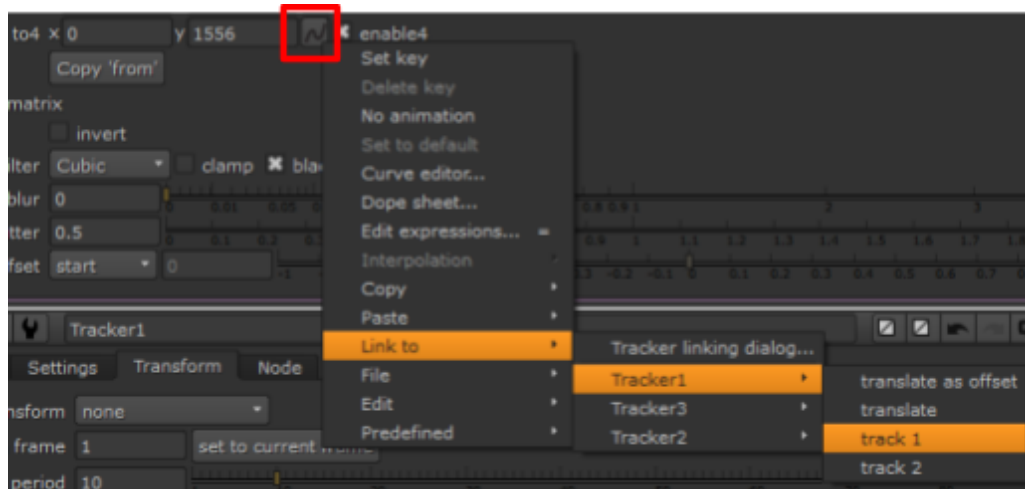
A common use-case for linking to individual trackers in a tracker node is when you want to superimpose an image on a screen. You can have a tracker node with 4 trackers, and link the position of each tracker to the corners of a CornerPin2D node.

NOTE: For more information on linking, see the Linking section of the main document.