

VICON iQ 1.5

Introduction

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Chapter 1**New Additions to Vicon iQ 1.5****Introduction**

This document aims to answer the all important question, "what is new in Vicon iQ 1.5?".

What follows is a detailed break down of the major additions to the release version of Vicon iQ 1.5 over the release version of Vicon iQ 1.0.

For existing Vicon iQ 1.0 users, this will give you a good understanding of the new features of Vicon iQ, and

where to find them. For new Vicon iQ users, this document, along with existing Vicon iQ 1.0 manuals will provide you with a good grounding for using Vicon iQ for the first time.

Improved Circle Fitting and 3D Reconstruction

An all new *Circle Fit and Reconstruction* Operation now exists in Vicon iQ 1.5, and completely replaces the old Vicon iQ 1.0 Circle Fit, Reconstruct and Trajectory Fit operations.

This new Circle Fit and Reconstruction Operation is found under the Pipeline Activity Bar, and boasts an impressive list of improvements.

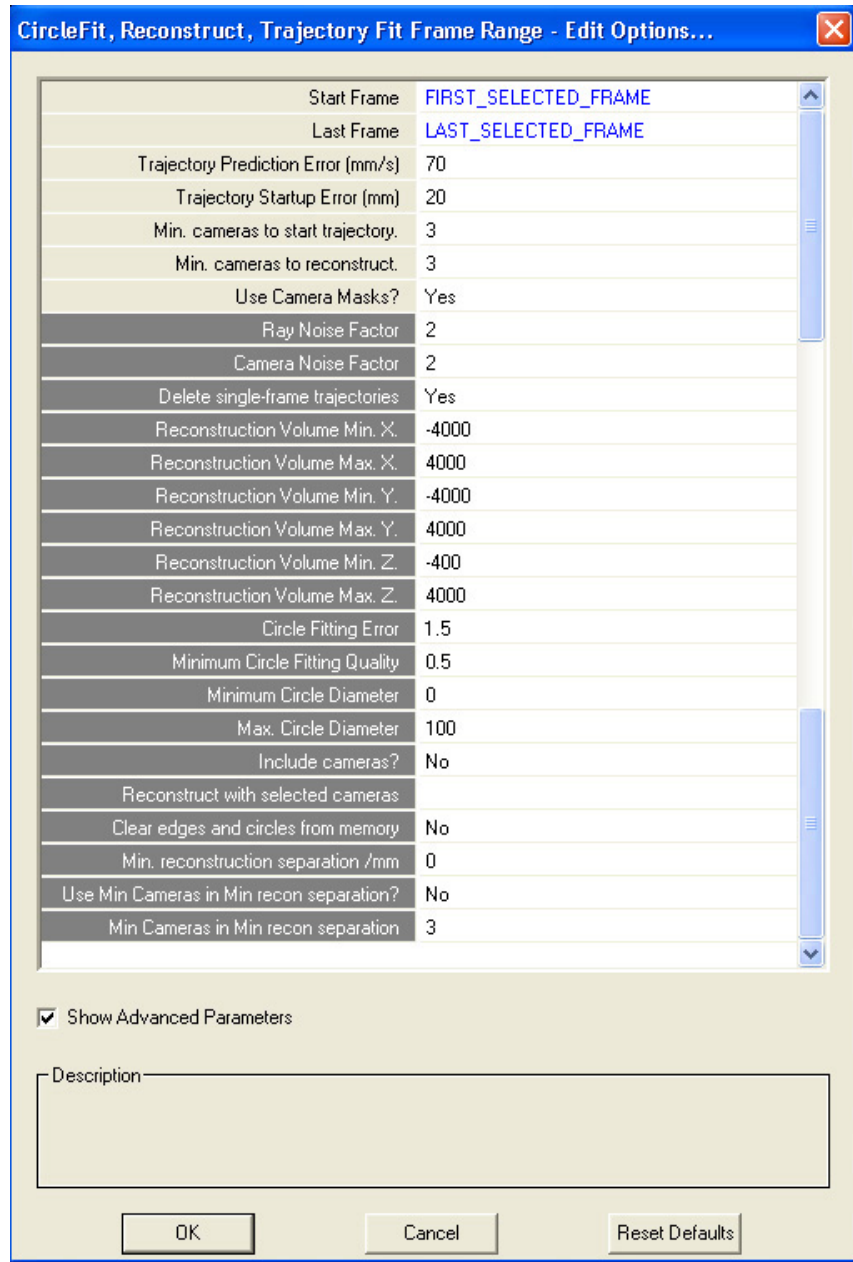
- Faster Reconstruction
- Better accuracy and integrity of 3D Trajectories.
- Improved Reconstruction for multiple actor capture
- Improved Reconstruction for simultaneous high detail face and body capture.
- Greater Control over reconstruction results
- Run Multiple reconstruction passes for different areas of your trial.
- Run Multiple reconstruction passes for different size markers. (face, hand and body)
- High power users will have the ability to prune out the data they do not want, and maintain all the important high quality data that they do want.

Along side these improvements, is a new related operation called, "*Trajectory Fit Frame Range*". This operation allows multiple passes to be made over any range of frames across all trajectories, labelled or not, and will attempt to fit 3D trajectories together based on dynamics over the entire trial. This operation takes similar prediction values as the Circle Fit, Reconstruct and Trajectory Fit operation, but allows you to process a trial in separate chunks.

A good example of this is with a capture trial of an actor swinging a golf club. Running the Circle Fit and Reconstruct Operation, with standard prediction parameters, will deliver great 3D trajectories for the body markers belonging to the actor. Vicon iQ can then process the body markers, and label them, but still maintain the golf club markers. By

running the Trajectory Fit Operation after labelling the body markers, you can specify different prediction parameters to improve the golf club markers, which are moving faster.

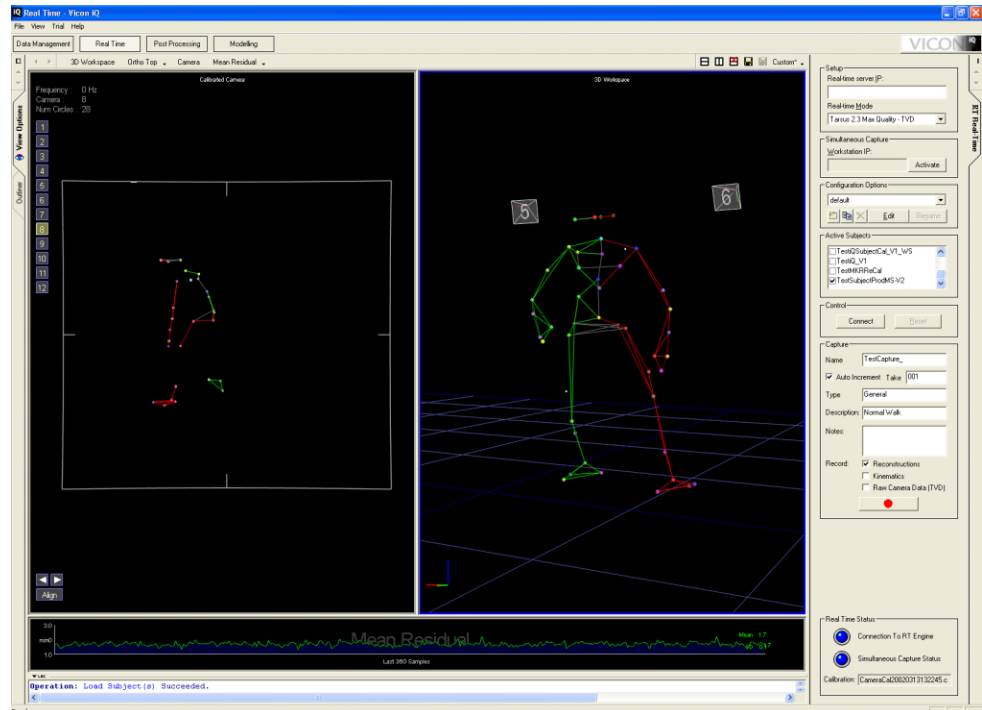
New Circle Fit and Reconstruction Parameters:



See detailed descriptions in Vicon iQ for these parameters, and please refer to accompanying documentation with respect to Circle Fitting, Reconstructing and Trajectory Fitting.

New Improved Real Time Mode

A new improved Real Time Mode is available within Vicon iQ 1.5.



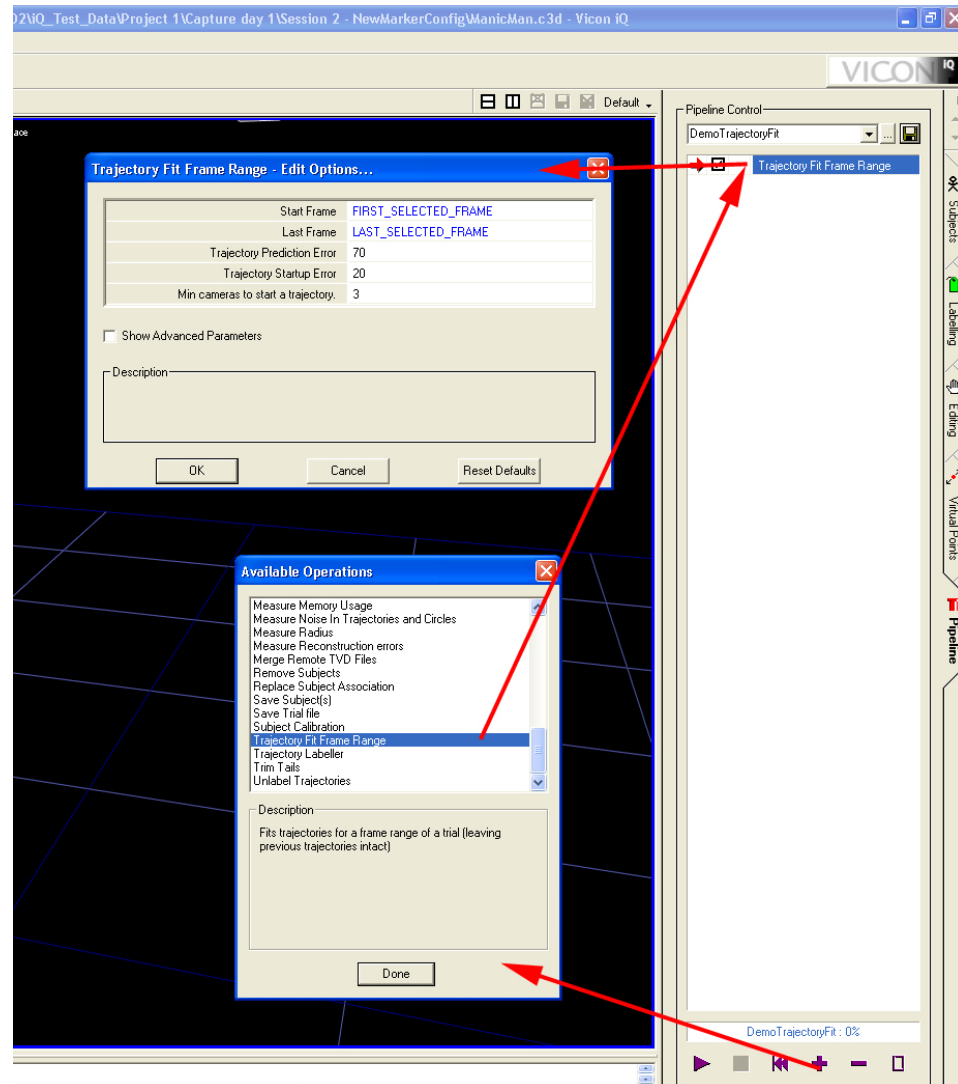
The following is available within the Real Time Mode of Vicon iQ 1.5

- All new Real Time Processing for Capture and Visualisation
- Display of Raw Camera Data, 2D edges, circles, labelled circles.
- Diagnostic display, calibration status, reconstruction rays, contribution rays etc.
- Improved Real Time Diagnostic Graphs
- New Maximum Speed, and Maximum Quality Modes.
- Record trials, and playback in Real Time.
- Record Raw Camera Data, 3D and Kinematics
- Improved Real Time Labelling and Kinematics.
- Direct Integration of capture trials and TVD into Data Management, along with Auto Incremented Take Number, Trial Info, Description and Trial Type.
- Remotely Connect to Workstation to trigger external device capture.

Unlimited Trajectories and Cameras Supported

Vicon iQ 1.5 can now support very large camera counts, over 96 cameras, and an endless ability to store 3D trajectories.

New Trajectory Fitting Operation



A new Pipeline Operation, has been included called "Trajectory Fit Frame Range", this Operation uses Dynamics to automatically concatenate labelled and unlabelled trajectories together. You can run this operation as many times as you like with different parameters. The operation runs best with 3D reconstructed data and with edges and circles still in memory. It will also run with just 3D reconstructed data present however, but you will not obtain the best results.

This Operation allows you to obtain perfect data from trials which may have an extreme mixture of fast and slow moving actors/props.

Example: A trial of an actor walking and swinging a sword has been reconstructed with normal reconstruction parameters. Both the Actor and Sword have markers reconstructed. The Actor has been reconstructed well, because they are moving normally, the sword however, is moving quickly, and will not have the best trajectories. By Labelling the Actor first, and then running this Trajectory Fit Operation, with faster dynamic settings, the Actors labelled reconstructions will remain, but Vicon iQ will join up the trajectories belonging to the sword, due to the faster settings. Now the sword can be labelled with more efficiency.

Improved Kinematics

Vicon iQ 1.5 has some improvements to the Kinematics, which are used for Subject Calibration, Kinematic Fitting, labelling, gap filling, and many other tasks fundamental to Vicon iQ.

The Kinematics are now faster and more accurate, with changes aimed at improving skeletal animation (from Kinematic Fitting) for actor skeletons, and character skeletons.

Improved Kinematic Fitting for Re-Targeting and Actor Mapping

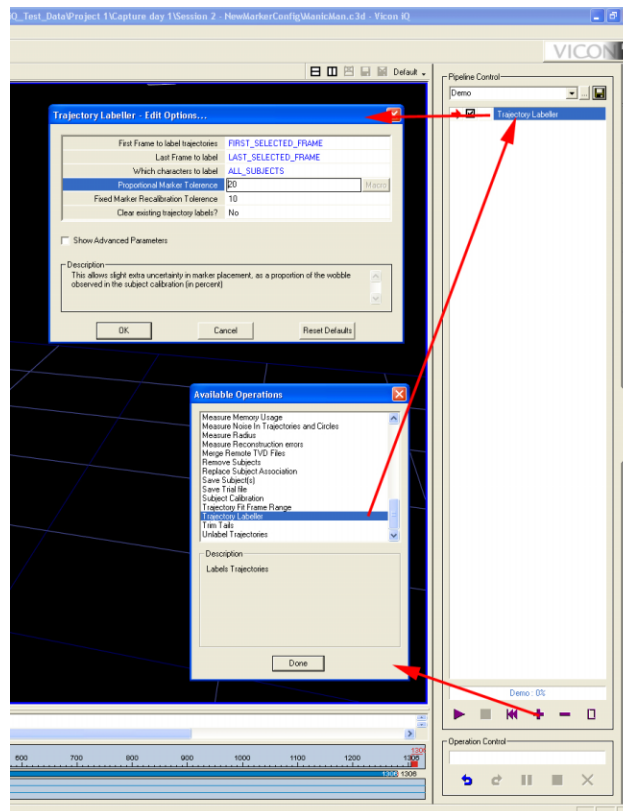
Kinematic Fitting can now be used for transforming the motion of captured markers to any custom skeleton, with industry leading results.

The Kinematic fitting uses a unique global optimisation engine to map the motion of any trial to any skeleton whilst maintaining end effector placement and the all important subtleness obtained from Vicon Optical Capture.

Character Skeletons can be exported from Animation Packages, such as Maya, or built directly in Vicon iQ's Modelling mode. (more on this later). Character Skeletons, can then be fitted to the Marker data, once it has been captured and cleaned using Vicon iQ's Post Processing Mode.

Improved Automatic Kinematic Labelling

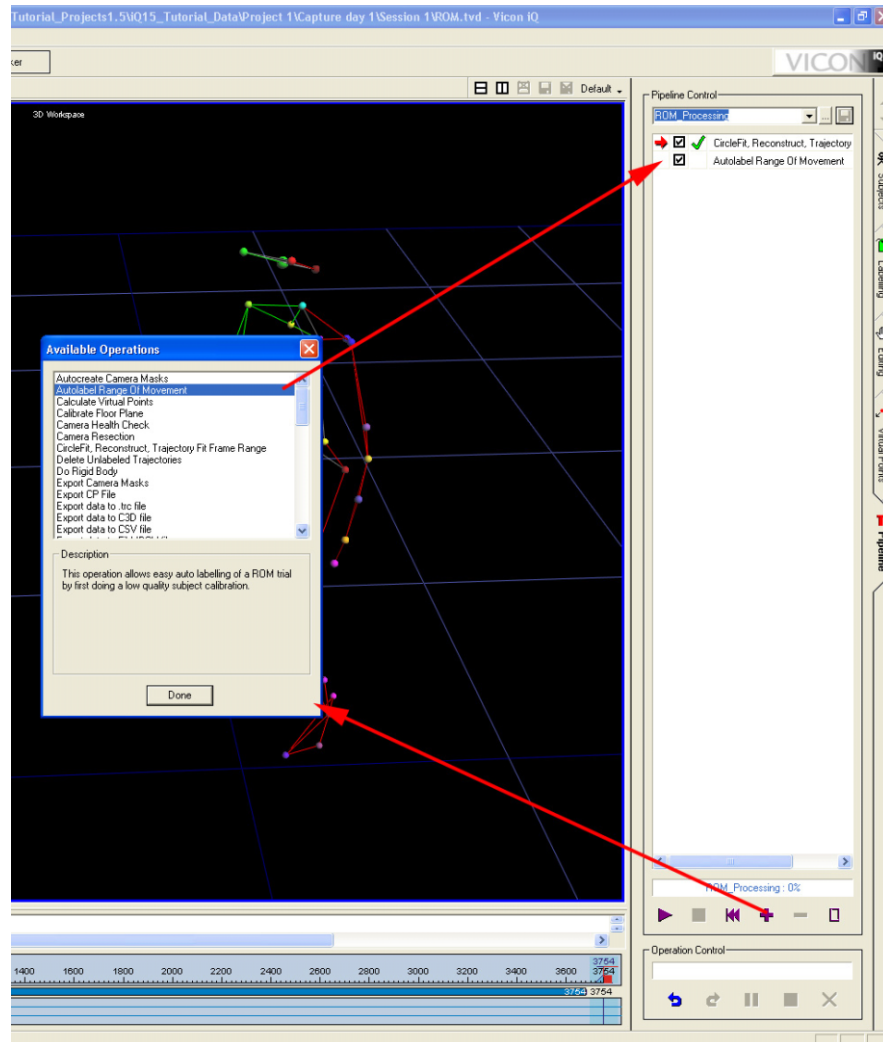
Vicon iQ 1.5, has better Kinematic Labelling, that will handle multiple actors and props with excellent results. The Parameters for Labelling have not changed, but the underlying processing has. You can find the Automatic Labelling, as a Pipeline Operation.



The Operation is called "Trajectory Labeller"

Automatically Label your Range of Motion

Vicon iQ 1.5 now includes a useful operation to automatically label most of your Range Of Motion trial, prior to running the subject calibration. This is detailed heavily in the *Vicon iQ 1.5 Subject Calibration Tutorial*.



The "AutoLabel Range Of Movement" Operation, can be found in the Pipeline Activity Bar of Vicon iQ 1.5

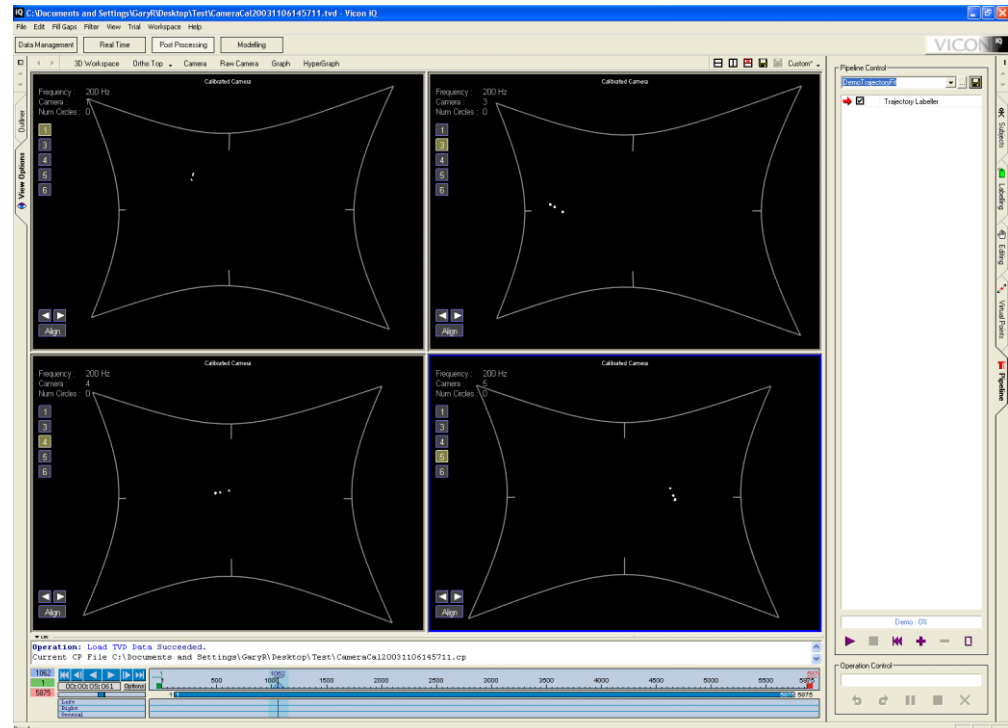
This Operation is designed to continue labelling the rest of the trial automatically, given that a few frames are labelled correctly.

The procedure would be:

- 1) Load your TVD ROM trial into Vicon iQ 1.5
- 2) Import the appropriate VST using the Subjects Activity Bar.
- 3) Manually Label the first frame of the ROM.
- 4) Run this Operation.
- 5) Check the results, and make any manual labelling steps that are required.
- 6) Run the Subject Calibration Process

New Camera Lens Model and Visualisation

Vicon iQ 1.5, now includes an accurate model for wide angle lenses, and a true visualisation of that model in Calibrated Camera Views.



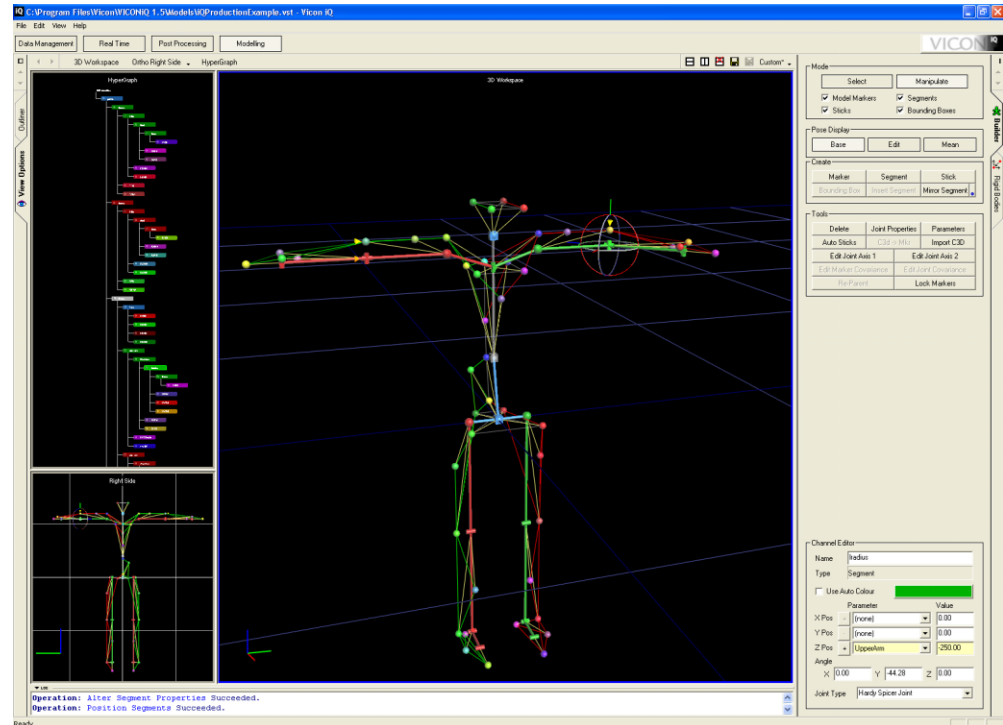
In the above image, you can see very wide angle lenses (100 degrees) being correctly modelled and corrected for.

This new model is used for all lenses, and adapts itself correctly to each lens type, based on calibration. The model is used during reconstruction to improve data quality and accuracy.

The largest increase in quality from previous versions of Vicon iQ 1.0, will be seen with cameras using very wide angle lenses.

New Modelling Mode

Vicon iQ 1.5 includes an all new Modelling mode.

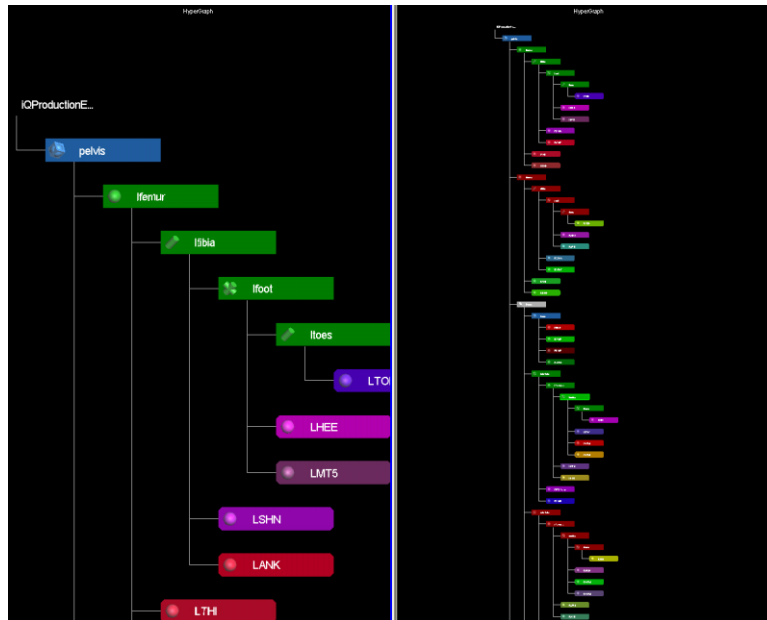


The Modelling Mode, allows you to construct from new, entire Kinematic Models, that can be used for process in Vicon iQ. Kinematic models can be used for labelling, subject calibration, gap filling and kinematic fitting.

Within the new Modelling mode you can:

- Create Kinematic Models directly from captured data. (import C3D frames into the model builder to use as reference)
- Create/Edit any Kinematic Model, humans, animals, quadrupeds, props etc.
- Create/Edit Segments(bones), define Joint Degrees of Freedom, constraints and behaviour.
- Create/Edit Bounding Boxes/sticks, and assign any colour to any element.
- Define how the markers are related to the underlying Kinematic Model.
- Define the importance and influence of markers over the Kinematic Model.
- Create Constraints within the Kinematic Model and Marker relations.
- Import and Export Custom Character skeletons to/from Vicon iQ.
- Use Multiple Orthographic and Perspective views during construction.
- Snap to, Plane alignment tools during all creation of Segments and Markers.
- Use Selection and Display Filters
- Use Mirror and Insert Tools when creating Models.
- Create Intelligent Rigid Body Templates for Post Processing.

New Hypergraph View.

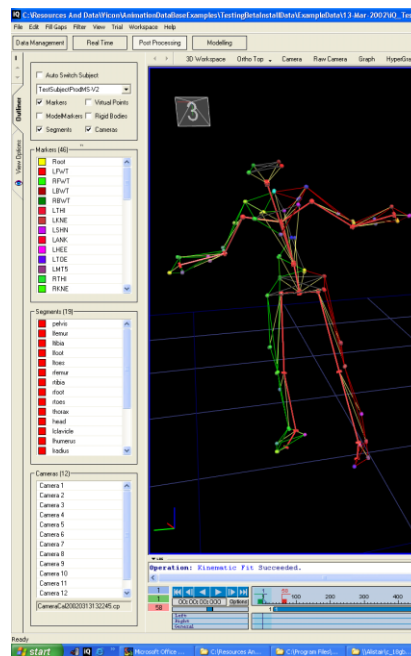


Newly added Hypergraph view for visualisation your scenes, models, and captured data. Allows quick and intuitive navigation of complex models and scenes.

This view is available in Modelling and Post Process Modes of Vicon iQ 1.5.

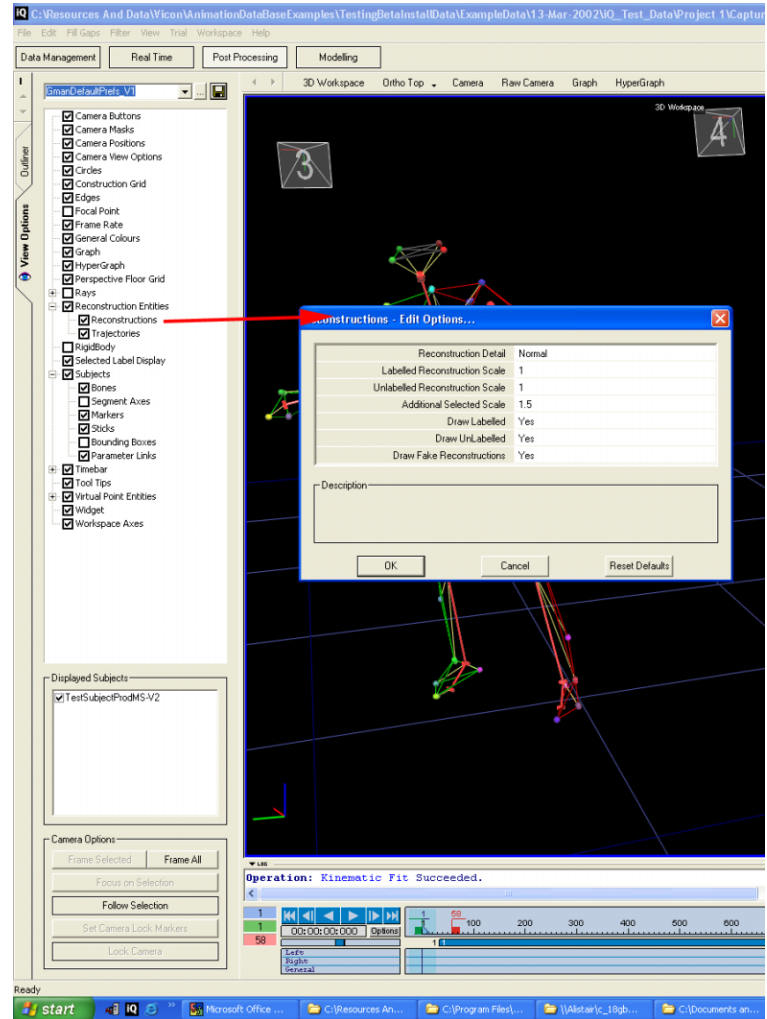
Improved Outliner View

Allows filtered display of Segments, Bounding Boxes, Markers, Cameras, Virtual Points, Rigid Bodies, and is available in all modes of Vicon iQ 1.5



Improved View Options

Improvements to the general View Options have also been made to Vicon iQ 1.5.



- The ability to Toggle the display of subjects, and associated trajectories.
- Lock the working Camera to specific coordinate systems (also accessible via hot keys)
- Follow Mode, Aim, Frame and Focus tools. (also accessible via hot keys)
- Extended View Option Dialogues, accessed by double clicking on the View Option entities.

The extended View Option Activity Bar, is available within all modes of Vicon iQ 1.5.

Advanced Subject Management Tools

Within the Post Processing Mode of Vicon iQ 1.5, there is now a new Activity Bar "Subjects", for providing general workflow tools for handling and calibrating your Kinematic Subjects.

The screenshot shows the 'Subjects' activity bar in Vicon iQ 1.5. The bar is organized into several sections: 'Create New', 'Import', 'Pose Display', 'Active Subjects', 'Calibration', 'Export', 'Tools', and 'Events'. Red arrows point from text labels on the right to specific controls in the interface.

- Create New:** 'Create Generic Subject (VST)' - Import VST (Subject Templates)
- Import:** 'Import Calibrated Subject (VSK)' - Import VSK (Calibrated Subjects)
- Pose Display:** 'Base', 'Edit', 'Mean' buttons - Set Pose display of Subjects (Base, Edit, Mean)
- Active Subjects:** List containing '[VSK] TestIQ_V1' and '[VSK] TestSubjectProdMS-V2' - Subjects currently loaded into 3D Workspace.
- Calibration:** 'Calibrate Subject' button - Calibrate Subjects (Kinematic)
- Calibration:** 'Re-Calibrate Markers' button and color selection area - Set Colour for Calibrated Subjects.
- Calibration:** Progress bar below 'Re-Calibrate Markers' - Subject Calibration progress Bar
- Calibration:** 'Re-Calibrate Markers' button - Recalibrate Markers
- Export:** 'Export Calibrated Subject (VSK)' button - Save Calibrated Subjects
- Tools:** 'Replace Subject' button - Replace Subject, and re-associated subject with Trajectories.
- Tools:** 'Remove Subject' button - Delete Subject.
- Tools:** 'Copy Subject' button - Copy Subject, and all associated trajectories for Backup, and for reference during editing.
- Events:** 'T' button - Mark General Events, and T-Pose (Subject Calibration)

Multiple Reference Subjects

Create Reference/Template copies of your subjects and data, for using as reference when filtering and editing data.

Easily maintain a copy of original data, visualise and compare changes that you make during editing.

This is available within the Subjects Activity Bar (previous)

Show/Hide Individual Subjects

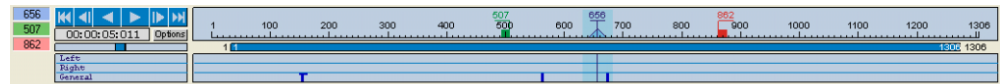
When working with complex multiple actor/prop interaction, you can now hide and show individual subjects.

This is available from the View Options Activity Bar.

Time Code Support

Vicon iQ 1.5, now supports full time code, display and storing of Time Code within Trail Files, C3D files, and within the DataManagement (eclipse) hierarchy.

Improved Time Bar and Controls



- Mark key events and reference them in the timeline. (Left, Right, General, T Pose etc.)
- Ctrl Click on Left/Right Selected Range Markers to set them to current frame.
- Double Click on Left/Right Selected Range Markers to toggle them to the start/end of trial.
- Drag in the timeline to set range of frames.
- Click to Set Current Time.

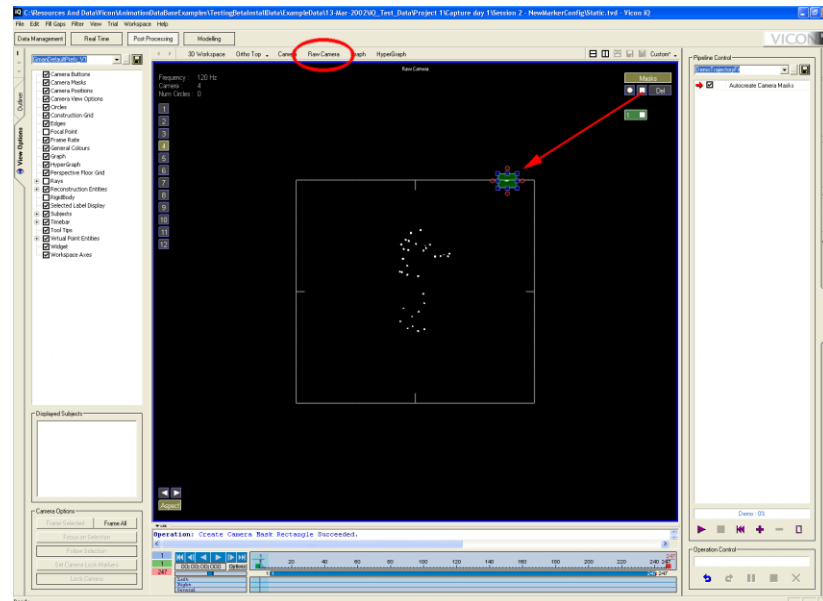
Improved Virtual Points

Vicon iQ 1.5, offers some improvements for the Virtual Point Tools within Vicon iQ 1.5

- Faster, and improved associations for automatic filling of gaps, using Virtual Point Templates.
- Automatic Dynamic adjustment and importance during filling gaps.
- Export Virtual Points to create new marker sets from existing data. (very useful for Character Studio Marker Sets)

Camera Mask Creation and Application

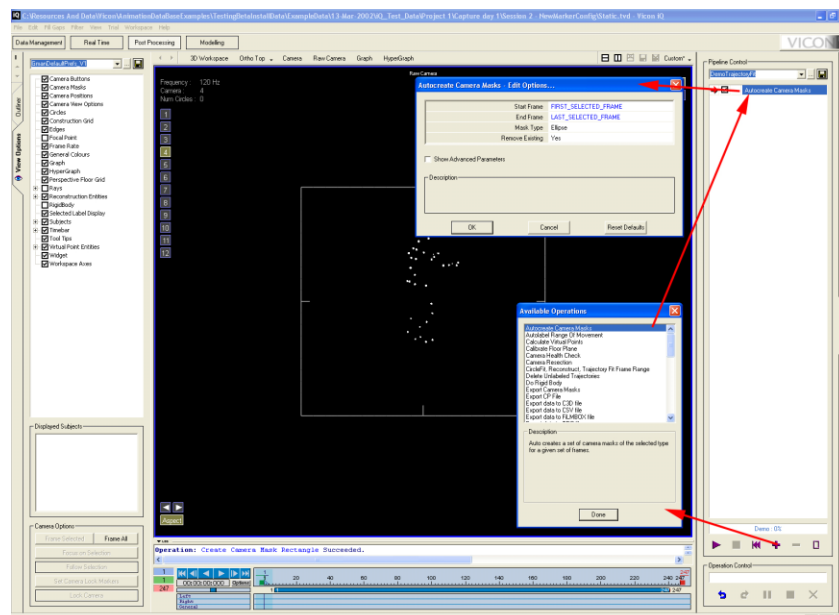
Vicon iQ 1.5 includes the ability to apply any number of cameras masks to Raw Cameras. Masks can be elliptical or Rectangular, and are used to mask out unwanted reflections or areas of individual cameras.



Manual Mask tools (above) are only available in Post Process, and only when display “Raw Camera” views. To Create a mask, simply click on the shape of the mask you would like to create (below the MASK button), and Left Drag in the Camera view to create the Mask. Once created you can manipulate the mask further.

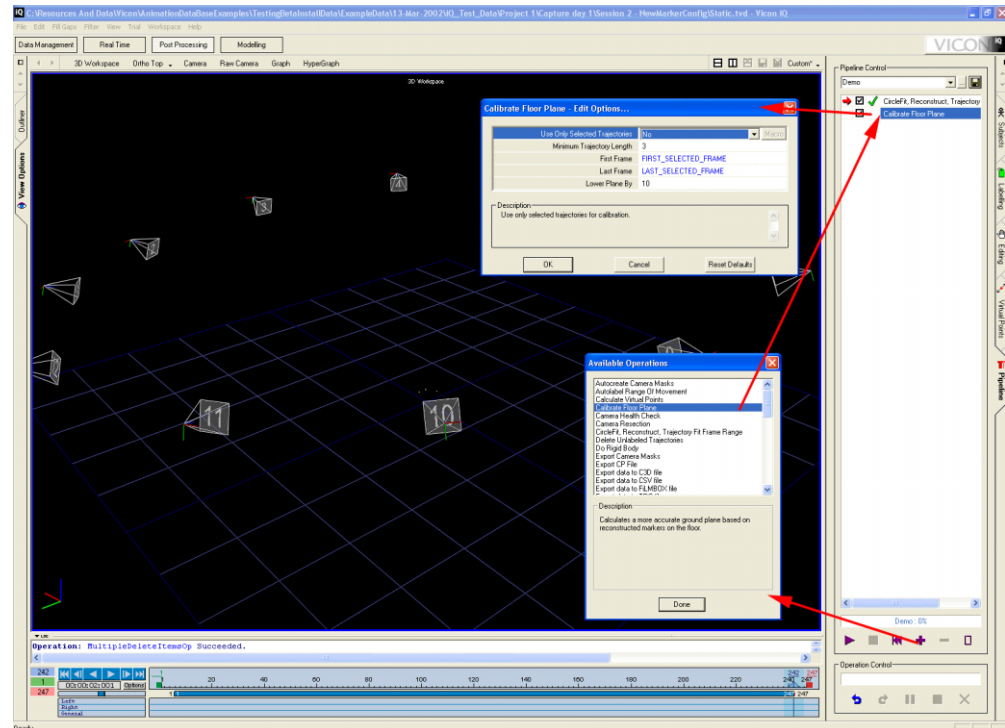
Masks can be exported as *.msk files, using the main drop down menu File->Export->

Vicon iQ 1.5 Also provides the ability to automatically create masks. Given a captured background trial, with no actors/props in the volume. This operation (AutoCreate Camera Masks), will automatically mask out all reflections seen.



Calibrate Floor Plane

A new Pipeline Operation, called “Calibrate Floor Plane” is included with Vicon iQ 1.5. This operation is accessible from the Pipeline Activity Bar within Post Process mode.



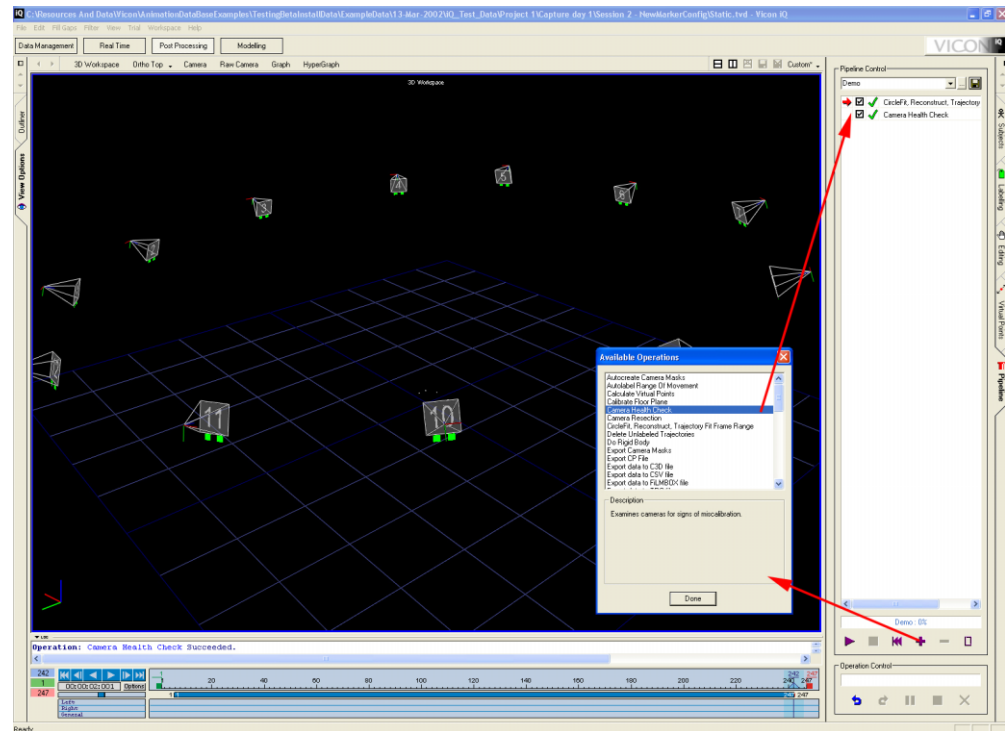
This operation takes a set of 3D trajectories in the workspace, and will fit a plane to these trajectories and then adjust the camera calibration so the fitted plane, becomes a perfectly level floor plane.

To use this Operation, the general workflow will be:

- 1) Calibrate the system.
- 2) Randomly place some markers all over the floor of the capture volume. Ensure no other markers are anywhere in the volume, other than on the floor.
- 3) Capture the floor plane, for 1-2 seconds.
- 4) Load the captured file into Vicon iQ 1.5.
- 5) CircleFit and Reconstruct the floor plane capture so unlabelled trajectories are displayed.
- 6) Set the “Lower Plane by” option in the options dialogue for the Calibrate Floor Plane Operation to $\frac{1}{2}$ of the marker diameter you are using.
- 7) Run the Calibration Floor Operation.
- 8) You will notice your cameras in the 3D workspace will change, due to the new calibration.
- 9) Export the new Camera Calibration out, by using the “Export Camera Calibration” Pipeline Operation, or using the main drop down menu “File->Export->CameraCalibration.

Check the Health of Cameras (Camera Calibration Status)

Vicon iQ 1.5 also has a method of being able to check and display the status of your camera calibration for each trial you have captured. This is especially useful for confirming you have good calibration, and to see if any cameras have been moved accidentally from trial to trial.

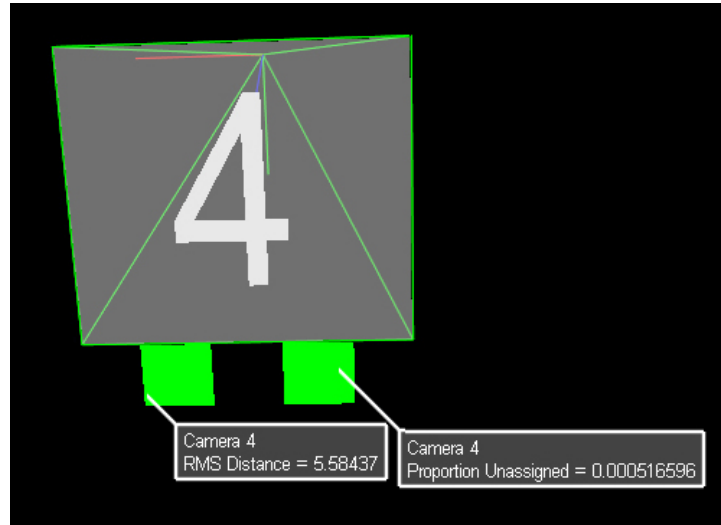


The Pipeline Operation “Camera Health Check” can be found in the Pipeline Activity Tab within Post Process Mode. (See above)

The workflow for checking the health of your cameras is:

- 1) Load a TVD trial.
- 2) Run the “Circle Fit, Reconstruct and Trajectory Fit” Operation, to reconstruct the data to 3D trajectories
- 3) Run the “Camera Health Check” Operation.

Once you have run the “Camera Health Check” Operation, you will see two lights on each Camera in the 3D workspace. You will also see a report of the health check within the Log Window.



For each camera you will see two lights, (above). If both lights are green, the calibration is good. If either of the lights are red, there could be a problem, and it is worth investigating. If either of the lights is blue, this means the camera could not be checked, due to no data being seen.

You can move the mouse cursor over each light on each camera, and a pop up will appear showing you some more information. This information is also displayed in the log for you to review.

As you look at the front of a camera, the left light indicates the RMS distance. The other light, right side, indicates the proportion of unassigned rays.

RMS Distance

This is an error value, which is in Normalised Camera Pixels (not actual camera pixels), between where the camera actually saw all of its markers, to where they ended up in 3D and back projected to the camera. If this value is less than 25, the calibration is fine. Anything above this, it does indicate the camera is out of calibration somewhat, and might need repairing.

Unassigned rays.

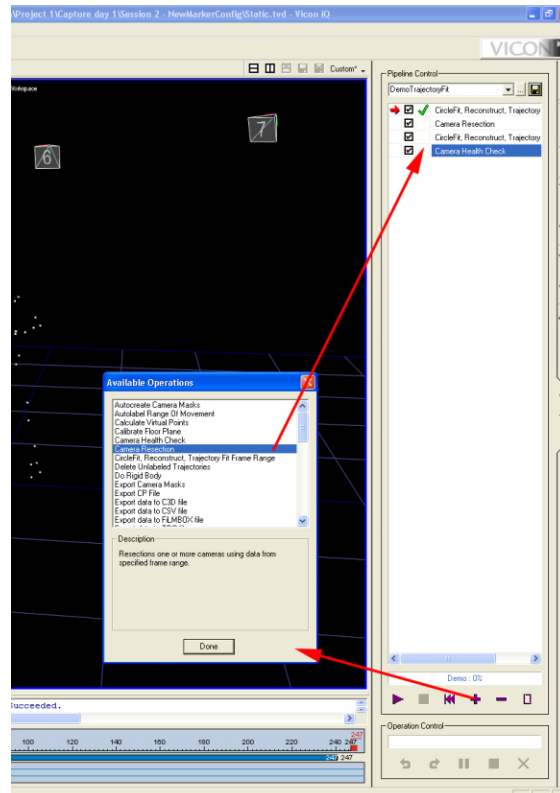
This shows the proportion of circles/rays that were actually used by the camera, for 3D reconstruction, in relation to the total number of circles/rays it saw.

If this value is high (above 20-40%) it can indicate 1 of two things. Either the camera is badly out of calibration, or some reflections are being seen (sunlight, another actor in the background etc.). If this light is red, it may be worth checking to see if any reflections are present in that camera view. If not, the camera is out of calibration.

If both lights are Red, this is a strong indication that the camera is out of calibration, and needs repairing.

Recalibrate Cameras just from Trial Data. (Camera Resection)

Vicon iQ 1.5 has the ability to recalibrate cameras completely just from regular captured trial data. This means you do not have to perform a full camera calibration, using the static and dynamic wand procedure, but can simply recalibrate a camera direct from your captured trial data with actors and props present.



You can find the Operation “Camera Resection” in the Pipeline Activity Bar, within Post Process mode.

The workflow for using this operation “Camera Resection” is as follows:

- 1) Load the trial TVD, which you suspect has a camera(s) that need re-calibrating or repairing.
- 2) Reconstruct the camera data to 3D trajectories, by running the “CircleFit, Reconstruct and Trajectory Fit” Operation.
- 3) Run the “Check Camera Health” operation to review the calibration status of all the cameras.
- 4) Select the cameras you wish to repair, (you can only repair a few cameras at any one time, Vicon iQ needs enough cameras other than the ones you are repairing to be able to reconstruct most of the 3D data).
- 5) And run the “Camera Resection” operation.
- 6) You should see the cameras you have selected, move position to where Vicon iQ believes the best place is for them.
- 7) Now run the “CircleFit, Reconstruct, and Trajectory Fit” operation, to reconstruct the 3D data using the new camera positions.

- 8) Export the Camera Calibration, to disk, for later use in subsequent trials. This can be achieved using a Pipeline Operation "Export Camera Calibration File .CP ", or by using the main drop down menu File->Export->Camera Calibration .CP"

Drag and Drop Support

Vicon iQ 1.5, now supports Drag and Dropping of files from Windows Explorer directly. Simply drag any of the supported files onto Vicon iQ, and they will automatically be loaded, and Vicon iQ will take you to the appropriate mode.

Export File Support

Vicon iQ 1.5, now supports several new file types for export.

- TRC File** ASCII Track Row Column File support. Vicon iQ will import/export unlabelled and labelled trajectories in TRC format.
- CSV File** ASCII Standard comma separated value format. Vicon iQ will export Trajectories and Segments (kinematic skeletons) to this format.
- FBX File** Kaydara FBX file support. Vicon iQ will export labelled marker trajectories to Kaydara's FBX format, for direct import to Kaydara's products and Plugins.
- V File** Vicon iQ will export both labelled marker trajectories and Segments (kinematic segments) to the Vicon V File format. V Files can be imported into any animation package using Vicon provided V-File Plugins.
- CP File** Calibration File (CP). Vicon iQ will export Camera Calibration files into a native Vicon CP file, for later use.
- MSK File** Camera MASK (MSK) file. Vicon iQ will import/export all camera masks to a native Vicon MSK file for later use.
- Improved C3D Support** Vicon iQ 1.5 has improved C3D file support to handle:
- Export of real labelled and unlabeled marker trajectories
 - Export of Kinematically modelled Marker trajectories
 - Export of Virtual Marker Trajectories
 - Export of oversized C3D Files (only importable into Vicon iQ)
 - Export of packed C3D Files (only importable into Vicon iQ)

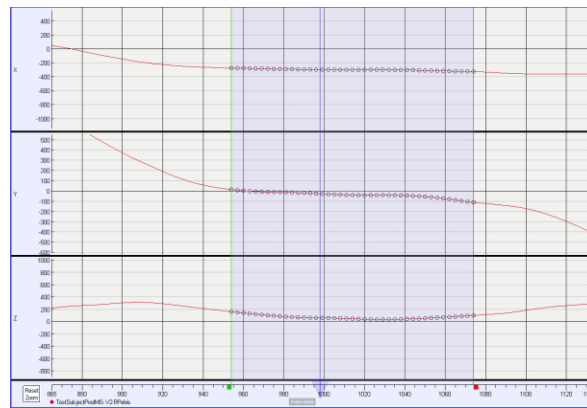
Improved Data Management

Vicon iQ 1.5 has improvements to the DataManagement Mode:

- Time Code support;/display. (dependant on Eclipse set up)
- Assign new Camera Calibration to Trials for Batch Processing This can be found under the main drop down menu "Eclipse->Change Associated Camera Calibration"
- Assign new Subjects to trials for batch processing and automation. This can be found under the main drop down menu "Eclipse->Change Associated Subjects"

Improved Graph Editing and Display

Vicon iQ 1.5 also has some improvements to the Graph Display and Editing Features.



- Proportional Zoom and Pan (ALT + RIGHT CLICK and Drag)
- Automatic Follow mode. (ALT -F)
- Aim, Frame and Focus Modes. (F, SHIFT-F, CTRL-F)
- Faster Display and Editing ability.

Improved Spike Finding Tool

Vicon iQ 1.5,now also has a new Spike Finding tool which can be found in Post Processing, under the main drop down menu "Workspace->Find Spike"

New Add Point Tool

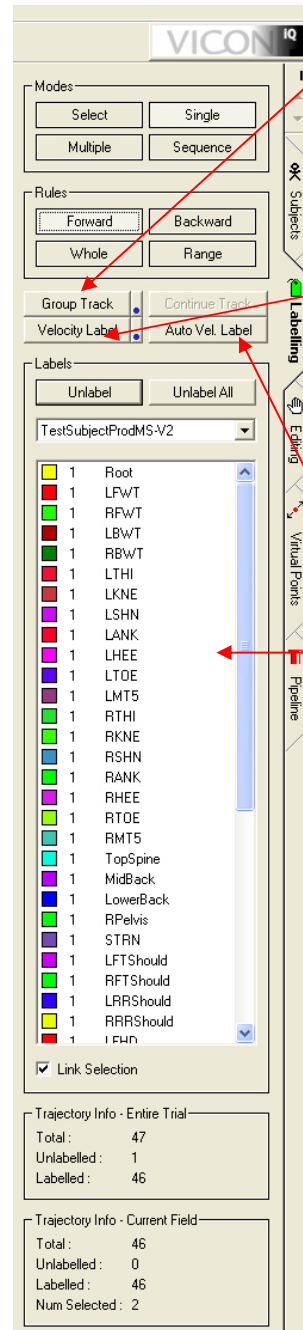
Within Post Processing Mode of Vicon iQ, you can also quickly Add a new data point (fake reconstruction) within the selected Marker. See Hot Key Guide also.

Improved Log Reporting

Vicon iQ 1.5, now also reports Warnings(orange), Errors(red) and successful(green) messages in the appropriate colour, and provides feedback from all operations.

New Semi Automated Labelling Tools

Vicon iQ 1.5 now also includes some semi-automated labelling tools, to help processing of complicated multiple actor trials. All of these can be found within the Labelling Activity Bar within Post Processing.



Group Track, automatically tracks groups of markers through time and labels them. To start a group track, select 3 or more labelled markers on a given frame, and run the group track. Vicon iQ will attempt to track the group (assumed to be semi rigid) over time, and make labelling selections for you.

Velocity Labeller, automatically tracks single markers through time and labels them if possible, based on dynamics. You can select more than one marker at any one time, and run the Velocity Labeller. Vicon iQ will use simple prediction and dynamics to attempt to label unlabelled trajectories accordingly.

Auto Velocity Labeller, when this is on, any labelling change you make, will automatically run the Velocity Labeller.

New Labelling Panel, intuitively displays markers requiring trajectories with a blue background. The number of trajectories is also assigned to each label is displayed.

Fast Selection and labelling in 3D workspace. When in Select Mode, any selection in the 3D workspace of a labelled 3D trajectory, will automatically select that for labelling in the list box.

Useful Labelling Hot keys.

- I Un-label single reconstruction at current frame.
- U Un-label entire trajectories at current frame.
- S Toggle Select Mode on/off
- CTRL → Find End of selected Trajectory
- CTRL ← Find Start of selected Trajectory
- ↑ Previous Marker
- ↓ Next Marker
- G Group Track
- C Continue Group Track

For other useful Hot Keys, please refer to the Hot Key Sheet, included with Vicon iQ 1.5