VICON
MOTION SYSTEMS

This section includes additional details about all aspects of the Vicon system. This includes a quick reference guide for toolbars and shortcuts, a glossary and trouble shooting guide.

QUICK COMMAND REFERENCE 03

GLOSSARY 08

FILE TYPES 13
Summary of Vicon File Types 13
Creating and Modifying Marker Set (MKR) Files 15

PROBLEM SOLVING 18
Available Help 18
Some common problems 18
Data Quality 26

FLOW CHARTS 27
System Setup 27
Database Setup (animation) 28
Database Setup (clinical) 29
Camera & Volume Setup 30
Subject Static Calibration 31
Main Capture 32
Trial Capture Data Cleanup 33
Real-time Setup 34
Real-time Subject Calibration 35

MANAGING VICON DATA: ECLIPSE 36
Creating a Data Hierarchy 36
More about Eclipse 38

INDEX 44

This quick reference guide shows comparable toolbar, keyboard, mouse and menu functions for Workstation. The tables illustrate the different functions available for each window.

Workstation: Toolbars

Function	Toolbar	Keyboard	Menu
Print			File | Print...
Save trial		Ctrl + S	File | Save
Open/close data directory window		F2	View | Data Directory
View reconstruction volume			View | Reconstruction Volume
View volume visualisation			View | Volume Visualisation
Calibrate cameras			System | Calibrate Cameras...
Open/close live monitors			System | Live Monitors
Activate Real-time capture			Real-time | Activate
Connect to Real-time engine			Real-time | Connect
Deactivate Real-time capture			Real-time | Deactivate
Disconnect from Real-time engine			Real-time | Disconnect
Set Real-time parameters			Real-time | Parameters...
Select Real-time subjects			Real-time | Subjects to Capture...
Read about the application			Help | About Real-time Workstation...
Autolabel trajectories			Trial | Autolabel

Function	Toolbar	Keyboard	Menu
Capture trial			Trial | Capture...
Set up pipeline			Trial | Pipeline...
Reconstruct trial			Trial | Reconstruct
Go to next unlabelled trajectory		F10	Workspace | Next Unlabelled Trajectory
Go to previous unlabelled trajectory		Shift + F10	Workspace | Previous Unlabelled Trajectory
Get context sensitive help		Shift + F1	Help | Context Help Mode

Time Bar: general use

Function	Toolbar	Keyboard
Play (forward)		Ctrl + Right Arrow
Play (reverse)		Ctrl+ Left Arrow
Stop		Space Bar
Step forward		Right Arrow
Step backward		Left Arrow
Go to previous event or start		
Go to next event or end		

Time Bar: gait analysis

Function	Toolbar	Mouse
Activate left event context		
Activate right event context		
Activate general event context		
Toggle general event		Select general event mode, then click on context bar
Toggle foot strike event mode		Select foot strike mode, then click on context bar
Toggle foot off event mode		Select foot off mode, then click on context bar
Erase all events		

The icons in the toolbar create a new node at the appropriate position in the hierarchy. The icons also appear in the hierarchy itself.

Data Directory

Generic Database	Science and Engineering	Icon	Entertainment (V series)	Icon
Top Level	Patient Classification		Project	
Subject	Patient		Capture Day	
Session	Session		Session	
Sub-session	Sub-session		Sub-session	
Trial	Trial		Trial	
Polygon Report	Polygon Report		Not available	

Within a trial these icons indicate the type of data available. Double-clicking an icon opens that data window in Workstation. Double-clicking the trial icon or the name of the trial opens the 3D Workspace window and, if available, a movie window.

Data Type	Icon	Notes	File Extension
Movie		MPEG format movies	*.mpg
Analogue		e.g., from Force plates	*.vad
Video		Unprocessed Video data, opens in monitor window	*.tvd
Processed		The Vicon virtual three-dimensional motion opens in Workspace window.	*.c3d

3D Workspace

Function	Mouse
Rotate the display about rotation centre.	Drag with left mouse button
Zoom in and out from rotation centre.	Drag with right mouse button
Move rotation centre with respect to display plane.	Drag with both mouse buttons
Select trajectory	Click on trajectory with left mouse button
Deselect most recently selected trajectory	Click right mouse button
View camera fostrum	Click on camera with left mouse button
Clear all camera selections	Shift + right click

Analogue Data window

Function	Keyboard
Decrease number of viewed traces	Shift + L
Increase number of viewed traces	L
Decrease timebase	Shift + T
Increase timebase	T
Decrease display gain	Shift + G
Increase display gain	G

Video Monitor window

Function	Button	Mouse
View previous camera		
View next camera		
View numbered camera		Click on the camera number
Add/remove numbered camera from view		Control + click on the camera number
View camera range		Click on one end of the range, then shift + click on the other
Zoom (in diagnostic mode)		Drag with right mouse button
Scroll (in diagnostic mode)		Drag with left mouse button

Analogue	Additional data recorded using dedicated analogue card in the Datastation, e.g., data from force plates or EMG measurements and audio.
Aperture	The opening in a camera, behind the lens, that controls the amount of light reaching the sensor plate. The size of the opening is measured in 'f-stop' numbers written in the form f/1.4, f/2.8 etc. The larger the number, the smaller the hole and the less light will enter the camera.
Autolabel	A Vicon feature allowing the labelling of a subject without user interaction. Available through the Trial menu.
Blooming	Term used to describe the defocusing of a picture due to excessive brightness. In Vicon this occurs when a marker is close to a camera with high sensitivity or the aperture is too large. The result may be misinterpretation of the marker as two markers. Solved by altering sensitivity and/or the aperture or possible by moving the camera.
BOB	Abbreviation of Break Out Box, a common name for a Camera Interface Unit. This is used to connect up to three cameras to a single port on the Datastation
BodyBuilder	Vicon application for data editing and modelling.
BodyLanguage	Scripting language used in BodyBuilder to create kinematic models.
Burn-in window	A small window added to a reference output video signal that displays Timecode or frame count and/or clapperboard information. Specified in Timecode setup.
C3D	Binary file format. C3D files are created whenever video data is reconstructed, labelled and saved. They may also contain analogue data and parameters.
Calibration Object	Objects comprising accurately spaced markers on a metal frame used to calibrate the capture volume.
Calibration Volume	The volume determined by the camera calibration process.
Calibration: Subject	Method used to store data about the subject in a session. The subject calibration allows you to label subsequent trials automatically.
Calibration: Cameras	Method used to measure the relative locations of all the cameras in the motion capture studio. The calibration is subsequently used in reconstructing the three-dimensional motion from the combined data from every camera.
Camera Interface Unit	This is used to connect up to three cameras to a single port on the Datastation.
Capture Space	The entire space available in your motion capture studio or laboratory.
Capture Volume	The actual amount of space in which you are able to capture data. It is the intersection of the reconstruction and calibration volumes.

CG Plug-Ins	Modules used to facilitate the import of Vicon data into a number of third party animation packages.
Context	A group of events that have something in common e.g., the left side or the right side
Context Bar	Displayed below the Time Bar ruler in Workstation and Polygon. Displays events and contexts.
Datastation	Purpose built hardware which captures all camera and analogue data. This provides the link between the cameras and analogue devices and the PC running the Workstation software
Defragment	Command used to ensure that Workstation or BodyBuilder recognise that all trajectories with the same label belong to the same trajectory. This is essential for some data editing options.
Depth of Field	The range of distance from the camera that is in focus. With a greater depth of field more items both near and far from the camera are in focus.
Dongle	A hardware security device that must be plugged into the parallel port of your workstation PC before Vicon software may be used. Supplied to licensed users by Vicon Motion Systems.
DynaCal	The method used by the Vicon system to calibrate your capture volume.
EBU	The European standard for Timecode. As defined by the European Broadcasting Union. In EBU mode the system expects cameras to be running at a multiple of 50Hz.
Eclipse	Vicon data management software. Eclipse is accessed through the data Directory window in Workstation and Polygon.
Event	An instantaneous action such as a ‘foot contact’ or a ‘foot off’. The Detect Gait Cycle Events plug-in will automatically place these on the context bar (needs force plates and analogue hardware installed and configured).
Field	A moment in the time span of a trial. The number of fields per second is defined by the frequency of the cameras used in capturing data.
Frame	Analogous to a frame in a motion picture, this is synonymous with field except for interlaced data, where a frame is composed of two fields (one even, one odd).
Gait Analysis	The study of human movement for medical purposes. Often uses force plates on which the subject moves to measure the changes in force as the movement occurs. These can be used to calculate changes in the joints. Vicon includes a set of tools for recording and analysing this data.

GenLock	Abbreviation of Synchronisation Generator Locking. With the appropriate hardware installed this allows the Datastation to be locked to other video equipment.
Interpolation	Filling a gap in a trajectory by calculating a smooth curve between the broken ends.
Inverse Kinematics	The deduction of movements of segments from a desired result rather than a measured motion. For example calculating the movements of leg segments with the requirement that the feet do not move. Note that such a calculation may have several possible results.
Iris	The part of the camera controlling the Aperture size. The graduations on the lens barrel are defined in terms of the focal length of the lens divided by the diameter of the aperture, the setting being referred to as the f-stop value.
Kinematic Model	Mathematical description of a moving object.
Label	A name by which a point or trajectory is identified.
Linearisation	This is a process of correcting for distortions in the camera lens and variations in the internal mounting of the camera sensor plate. The correction factor is calculated as part of the volume calibration.
Marker	The retro-reflective spheres or hemispheres attached to your subject are called markers.
Marker Set	The file listing the markers attached to the subject of motion capture. The file can also include information about how the subject will be displayed in the workspace, body segments and modelled data.
Mobius	The Vicon application for the artistic editing and manipulation of motion capture data.
Motorcycle Pose	Also called the Neutral Pose, this is sometimes used by the subject when capturing a static trial. It aims to optimise the Autolabel function.
Pipeline	The Vicon automation feature that allows selected procedures to take place following data capture. These procedures are selected in the Pipeline dialog opened from the Trial Data Capture and Trial Types dialogs or directly from the Trial menu. Data processing modules accessed through the Pipeline in Workstation. Several are shipped with Workstation though you may create your own using the Plug-in Software Development Kit (SDK).
Plug-ins	The Vicon data analysis and reporting tool.
Polygon	Technique used to capture events that have already happened, for example when

Post-Triggering trying to capture moves of subjects whose movement is difficult to predict such as animals and children.

Preferences Each Vicon application includes a Preferences command in the File menu. This dialog allows you to customise the application you are using.

Reconstruction The calculation of the position of a marker in three-dimensional space and the linking of these points into a trajectory.

Reconstruction Volume A user specified reconstruction parameter that specifies the space within which the system will attempt to reconstruct marker data.

Root If a segment in an autolabel marker set is labeled Root then the autolabelling process will begin by identifying this segment. This often makes the process more effective.

Sample Skip Used to reduce the amount of data captured. For example if your cameras run at 120Hz they capture 120 frames every second. Using sample skip setting the video rate divider to 2 reduces the effective sample rate to 60 frames per second.

This is useful when capturing slow moving subjects, capturing for long periods, using large numbers of subjects with many cameras or any other time when you may wish to reduce the amount of data, perhaps if you have limited storage space.

Segment Sample skip is set using the Trial Data Capture dialog and the Trial Types dialog.

SMPTE In a kinematic model, body parts are represented by segments.

The world standard for Timecode, as defined by the Society of Motion Picture and Television Engineers. In SMPTE mode the system expects cameras to be running art a multiple of 30Hz.

Spike A point that lies to one side of an otherwise smooth trajectory. Spikes often occur as a result of a poor reconstruction in a particular frame.

Static Trial A short capture during which the subject stands still. Used for setting up the Autolabel feature.

Subject Calibration The process of creating or modifying a Subject for autolabelling purposes. This allows the software to automatically label trajectories in the 3D Workspace.

Time Bar A controller for viewing motion capture data, e.g., start and stop forward and reverse playback.

Timecode The digital equivalent of the information printed along the edge of traditional motion picture film. This was introduced by the broadcast industry to allow clear identification of positional information (frame details) on magnetic videotape. Using timecode with video and TVD data allows the user to obtain a more precise reference for editing data. The ‘code’ is an eight digit number specifying hours,

Trajectory	minutes, seconds and frames. The path though space followed by a marker. This information is stored in a C3D file as a time-series of points with the same label. You can display a trajectory in the Workspace window as a line through the position of a marker in the current field. A trajectory may consist of a single uninterrupted path or as a number of segments. The latter occurs when markers may be obscured from view.
Trial	A trial is an act of data capture. Also refers to resulting C3D file.
TVD	The file format for the unprocessed video data captured by the Vicon system.
Video Burn-in	A small window added to a reference output video signal that displays Timecode or frame count and/or clapperboard information. Specified in Timecode setup.
Video Data	The data captured using the Vicon cameras and Datastation. Not to be confused with that recorded using a digital video camera, which is referred to as Movie data.
Volume or Capture Volume	The three-dimensional space in which motion will be captured.
Wand	Device used for dynamic calibration of the Vicon system. A rod with two markers placed a fixed distance apart.
Workspace	The 3D Workspace is used to view three-dimensional motion capture data. Most Vicon applications have a workspace window.
Workstation	The software that controls the Datastation. This will be installed on a PC linked to the Datastation via an Ethernet based Local Area Network. Note that many people also refer to the controlling PC as the Workstation.

Summary of Vicon File Types

The Vicon system produces and uses several different file types. Most files are managed automatically, so file formats are not normally relevant. If you do need to know about a particular file format (for instance, if you are writing custom analysis software), contact your Vicon representative.

File Extension	Description
C3D	Binary file created when video data is reconstructed. Also contains analogue data and parameters.
CAR	All parameters required for Vicon capture and reconstruction. In general these are changed using the System menu Setup commands.
CP	Calibration parameters for a set of cameras. Created during camera calibration and used when data from these cameras is processed.
CRO	Coordinates of markers on calibration reference objects. Can contain information on several calibration objects.
CSM	Character Studio Motion Capture file. Created using the pipeline to export data to 3D Studio Max.
ENF	Eclipse Node File. Contains all information about a specific node level in the Data Directory.
ENI	Eclipse Node Initialisation file. These are the template files Eclipse uses for defining the hierarchy of nodes.
INI	Defines application wide characteristics independent of the user. This should not be edited by the user.
KM	Kinematic Model file. Created using the pipeline options Distance Statistics Collection; used by the Kinematic Fitter pipeline option.
KMT	Kinematic Model Template. Used to generate KM files.

MKR	Information about a specific marker set. A detailed description is given below.
MPG	Movie file format used by Vicon, commonly known as MPEG. Should not be confused with video data – the data captured by your Vicon cameras.
OBD	Information on fixed objects (such as furniture) in the workspace.
SP	Calibration parameters for a subject. Used for the autolabelling process.
TVD	Binary unprocessed data created when video data is captured. This is the data used for reconstruction – which in turn produces the C3D file. Also created during camera calibration.
V	Created using the Kinematic Fitter pipeline option to export data to various graphics packages.
VAD	Binary unprocessed data created when analogue data is captured.
VPI	Vicon Plug-in.
VSK	Vicon Skeleton file. Created using the pipeline options VST Calibrator and VST Statistics Collector; used by Real-time.
VST	Vicon Skeleton Template. Used to generate VSK files.
WAV	Compressed audio wave file generated from capture analogue audio data using the pipeline.
WKS	Details of the floor dimension and placement of fixed objects (such as furniture) in the workspace.

There are also several other file types created by older systems (e.g., LP, SES, USR). These can be read by Workstation but have been superseded.

Creating and Modifying Marker Set (MKR) Files

The MKR file is a text-based file that may be edited in Notepad, and contains one or more marker sets. If you create or edit a marker set, the file should be saved with the extension .mkr. Examples may be found in the Models sub-folder of your main Vicon folder.

The file begins with a line containing the file type identifier:

!mkr#2

This is followed by a line containing the name of the first set in square brackets, such as

[Autolabel]

Types of Marker set

Marker sets can be used for two purposes, display and autolabelling. A display set allows data to be viewed in a specific way by focusing on a particular combination of points and links. It will contain two elements:

- A list of marker labels
- Links between labels for display purposes

A special set named [Autolabel] is used to describe the marker arrangement used in the trials to be labelled. Autolabel sets contain the following elements:

- A list of marker labels
- A list of labels belonging to rigid body segments
- Links between rigid body segments

List of Marker Labels

Each label appears on a single line, and may be a maximum of 30 characters long, containing only letters and numbers. The label may be followed by a space and a short description. It is normal for labels to be short and in capital letters, but this is only a convention. The description may be up to 32 characters. For example

LANK, The left ankle

The list may include labels which are not necessarily used in every trial. For example, you may allow for alternatives, variations or additional markers for props.

The second element of a display set is a list of links for display purposes. These will appear in the Workspace Window as green lines joining the markers named.

Links for Display Purposes

The simplest way to define a link is with a line containing the names of the two markers, separated by a comma:

LKNE, LANK

A closed chain of links may be defined by listing any number of markers on a single line, separated by commas, for example:

SACR, LASI, RASI

This would cause the markers listed to be joined by a ring of links, that is, the last marker listed is joined to the first.

Vicon determines the type of each line by its content. Line types may therefore be mixed in any order, as long as a label is listed before it is used in a link.

The list of rigid body segments is only needed in the [Autolabel] set. Each entry in the list contains a group of markers that belong to the same segment, and therefore maintain approximately fixed separation from each other. The names of the markers belonging to one segment appear on a single line, separated by commas. All the marker names used must also appear in the list of marker labels. Some markers may be included in the definition of more than one segment. Not all the markers listed in the segment definition element must appear in a trial to be labelled.

Each segment may be given a name of up to 32 characters, which appears at the beginning of the line, followed by an equal sign. For example:

LeftShank = LKNE, LTIB, LANK

LeftFoot = LANK, LHEE, LTOE

The simplest form of segment definition, without a name and equal sign, is identical to the form of the definition of a ring of links, used in a display set to join several markers

together in a closed chain, and has the same effect; the markers listed in a segment definition line will be linked together by green lines in the Workspace window.

One segment may be named Root. The autolabelling process will then begin by identifying this segment. It often makes the process more effective if a Root segment is defined.

Segment Linkage List

The connections between the segments are described using segment link lines, which contain the names of two segments, separated by a comma. The segments must first be listed in the segment definition list. For example:
LeftShank, LeftFoot Such a segment linkage line indicates that the two segments have a common joint. This is called an explicit link. However, if two segment

definitions share a marker, the implication is that the segments are linked at that marker (or on an axis through that marker). This is often the case at elbow or knee joints, for example. Such implied links are detected when the segment definitions are read, and do not need to be repeated in the segment linkage list.

If there is a segment with only one marker on it, the name of that marker may be used in place of a segment name.

No complex system can be completely foolproof, and you may occasionally run into difficulties. This manual provides comprehensive information on all aspects of the Vicon system. Additional resources are detailed here, along with a short problem solving guide for common problems

Available Help

Online Help

Workstation includes an extensive online "What's this?" Help system. This gives you information on screen elements, dialogs, workspace windows etc., as you are working. To enable Online Help either:

- Select Help | Context Sensitive Mode

Or

- Click the What's this? Icon

You can then click on any of the visible screen elements you see in front of you. The help information appears in a pop-up window. To close the window, click anywhere on the screen.

Online support

Registered Vicon users can use the Support Web Site to search the support database for all known issues. To use the database:

- Point your browser at the URL: http://support.vicon.com.
- Enter your user name and password
- Search the database

If you do not have a user name and password contact support directly and they will be happy to activate your account: e-mail support@vicon.com

Some common problems

Note that there may be a number of explanations for certain symptoms, and each will have its own solution. The following list presents a symptom followed by the possible reasons for the problem and the associated solutions.

Nothing is visible in the live monitor window

Reason	Solution
No reflective markers are in the capture volume	Put some markers on the floor to show where the volume is.
The aperture of the camera is closed.	Open the aperture to a value between f8 and f2.8 to ensure that sufficient reflected light from the markers can enter the lens

Markers are too far from the camera	Typically, the recommended distance from camera to marker is 12m for a 9mm lens. This is reduced as the lens gets wider.
The strobe is not synchronising with the camera.	Check that camera is connected to the strobe. Look to see that the lead between the camera and strobe is connected and correctly seated.
The hardware is not connected properly.	Check all your cables are plugged in correctly and the hardware LEDs are illuminated. Switch power on to Datastation and once booted, select System | Start Link and then System | Live Monitors whereupon the strobes should illuminate.

Can't get a link between Datastation and Workstation

Reason	**Solution**
The cable connecting the Datastation and Workstation is not of the correct type.	If using a hub, ensure that you use standard network cables. If connecting directly, use a crossover cable.
The network is not set up correctly.	Check you network setup with the details given in the Preparation section of this manual. If necessary consult your Network Administrator.

The data rate is slower than expected.

Reason	**Solution**
Your Datastation is connected to a network or PC that has a 10Mbit network card installed. The Datastation network will automatically default to the slower speed.	Change the offending card or connect the Datastation to Workstation as a standalone network. If you are in any doubt about the speed of the network with a switchable card, it is possible to buy a hub that will display the speed of its traffic.

Can't see the red visible strobe ring

Reason	Solution
You are using cameras with infra-red strobes rather than visible red strobes	Move a marker in front of camera and check that it is visible in the Live Monitor view.
You haven't established a link.	In Workstation select System | Start Link to try and start the link. If this does not work, check all connections between cameras, Camera Interface Units, Datastation and Workstation.

The usable area or green circles aren't visible

Reason	Solution
View parameters set incorrectly.	First select View|Usable Area to display camera identifier and usable area. Then select View|Detected Markers|Solid and View|Recognised Markers|After Validation to display circles.

The marker circles in the live monitor view are flickering

Reason	Solution
View parameters set incorrectly.	Select View | Flicker Free.
The markers are blooming due to being too close to camera.	Adjust aperture and/or sensitivity using near and far approach to ensure that the marker seen as a circle at both edges, or else re-position the camera to have sufficient separation from the near edge of the volume and then adjust aperture and sensitivity accordingly.
Camera may be out of focus.	Check that lens focus is set to infinity. If the image is still distorted, check the back focus.

The live monitor view is displaying an unsynchronised image – flashing lines, etc.

Reason	Solution
The video set-up in the Workstation does not match the camera type.	Select System | Video Setup... and choose correct camera type from list. Apply this to the current session and check the new type as the default.

The usable area in live and video monitor view is only a proportion of the full view

Reason	Solution
The video set-up is incorrect.	Select System|Video Setup..., choose correct camera type and apply to current session.

Calibration residuals are higher than expected

Reason	Solution
Insufficient wand data	Repeat dynamic calibration only, ensuring that you capture about 20 seconds of data of wand wave distributed evenly throughout the volume.
Camera/s out of focus.	Check lens focus set at infinity and if necessary the back focus of each camera. If focused incorrectly, re-calibrate and apply to a new session.
Cameras are poorly oriented with respect to each other.	Check the mrcalib.tvd, the video capture of the most recent calibration, in \VICON\SYSTEM\ and use View|Calibrated Marker Pairs to confirm calibration is using only calibration device for process and not random strobe head. If so, reorient or locate camera to avoid incorrect marker pair selection.

A Group of cameras failed to calibrate

Reason	Solution
Insufficient wand data.	Repeat dynamic calibration only, ensuring that you capture about 20 seconds of data of wand wave distributed evenly throughout the volume.
Cameras don't have sufficient overlap to propagate the calibration.	Re-position the cameras to ensure that all regions of the volume are 'seen' by at least two, ideally, three cameras.
Other visible light sources are flickering causing multiple false centres.	Reduce the camera sensitivity so that the light source appears as a single static centre. Verify markers are not in view of cameras during calibration.

Calibration failure in systems set up to capture hand and face

Reason	Solution
Reflections due to glasses, wristwatch or rings. They are visible due to fact that aperture is opened up to see smaller markers. Calibration fails because they are not in constant view and can be misinterpreted as wand markers.	Remove all highly reflective objects and check live monitor view for any other reflective objects.

Reconstruction generates a large number of trajectory segments

Reason	Solution
Loss of calibration due to cameras being knocked / moved.	Start a new session and re-calibrate your volume.
Incorrect reconstruction parameters.	Capture a straightforward trial and experiment with reconstruction parameters such as Intersection Limit and Residual Factor. Also check that the maximum and minimum vectors encapsulate your volume (Reconstruction Volume).
Lots of occlusions take place.	If they are avoidable, repeat actions; otherwise consider re-positioning the cameras to minimise regions of non-visibility.
Subject walks in and out of capture volume.	Capture trial only when subject is inside volume or set trajectory save range to only save data when all markers are visible.
Incorrect camera sensitivities causing marker merging and false trajectories.	Adjust camera sensitivities so that you can differentiate markers close to each other.
Poor coverage of the capture volume. The overlapping regions of the cameras are insufficient to allow reconstruction. .	Re-position the cameras to ensure that all markers can be seen by at least two cameras throughout the volume.

Reconstruction creates fewer trajectory segments than the number of visible markers

Reason	Solution
Incorrect reconstruction parameter settings.	Adjust parameter values such as reducing the Intersection Limit.
Specific body segments occluded throughout trial by props or other subjects or lying on floor.	Move the occluding objects or re-position them within volume.
If objects are supposed to be there then re-position cameras to provide sufficient coverage of the volume ensuring that all markers can be seen by at least two cameras.	Check markers in live view to assure proper reflectivity. Dirty markers will not work as well as clean markers.

The trajectories of two markers keep flipping between each other

Reason	Solution
Incorrect reconstruction parameters.	Gradually decrease the predictor radius in the reconstruction parameters, until flipping stops occurring. But be aware that changing this value will impact other areas of reconstruction so check other areas of the trial to ensure optimisation of predictor radius parameter.
Markers too close on actor.	Check in the video view of a capture to see if this is the reason prior to making any changes to marker positions. By using View | Recognised Markers | After Correction Only, you will be able to display when the images of two markers becomes close, whether the system sees them as two markers or one marker. If the system is consistently merging markers in this way in many views, it may be necessary to move the markers further apart on your actor, or alternatively bring the cameras nearer to the actor. Remember the system cannot only reconstruct what it can see.

Trajectories aren't reconstructed

Reason	Solution
Incorrect reconstruction volume parameters.	Select correct maximum and minimum vectors to ensure capture volume is included. Remember that positioning of L-Frame will determine origin.
Fast moving data (e.g. golf balls) seen for fewer than 5 frames.	Markers need to be seen in at least 5 frames to be calculated using reconstruction parameters. Capture at a higher video frequency.

Feet disappearing in reconstruction

Reason	Solution
Uneven floor surface and incorrect reconstruction volume parameters.	Set minimum z vector to a value of say -100mm (more if the floor is very slanted).

Reconstruction generates lots of ghost markers

Reason	Solution
Marker merging due to high sensitivity settings.	Adjust camera/s sensitivities to ensure that all markers are differentiable from each other at both near and far edges of volume.

Left and right limbs are labelled incorrectly

Reason	Solution
Subject has been labelled incorrectly.	Check subject C3D to verify. Correct labelling error and recreate subject file.

Workstation open but there is no Data Directory window

Reason	Solution
The directory was closed by mistake. The option has been switched off in the User Preferences dialog.	Press F2. Select File | Preferences and select Open Data Browser Window

Autolabelling is not labelling properly

Reason	Solution
MKR file is not correct for number of markers used.	Check that the marker set used has sufficient markers defined for your subject. A marker set may have more labels available than necessary, but not too few.
MKR file not written properly.	Check the Marker set against the definition in this chapter. Try one of the Vicon sample marker sets.
Too many gaps in the data.	Consult Data Editing in the Essentials of Motion Capture section to fix problems with broken trajectories.
Markers may have moved too much after Autolabel calibration was set.	Check positions, calibrate subject again.
Wrong subject used.	Select correct subject in Trial Options dialog (Trial | Options menu). Autolabel again.
More subjects selected than are in the trial.	Open Trial Options dialog (as above) and select the correct subject only. Autolabel again.

Data Quality

You should also become familiar with the use of the Live monitor or Video Monitor window to assess the quality of the video data. Normally at least two video lines should be available for the system to estimate the centroid (the center of the marker) position and at least three for a more accurate calculation to be made.

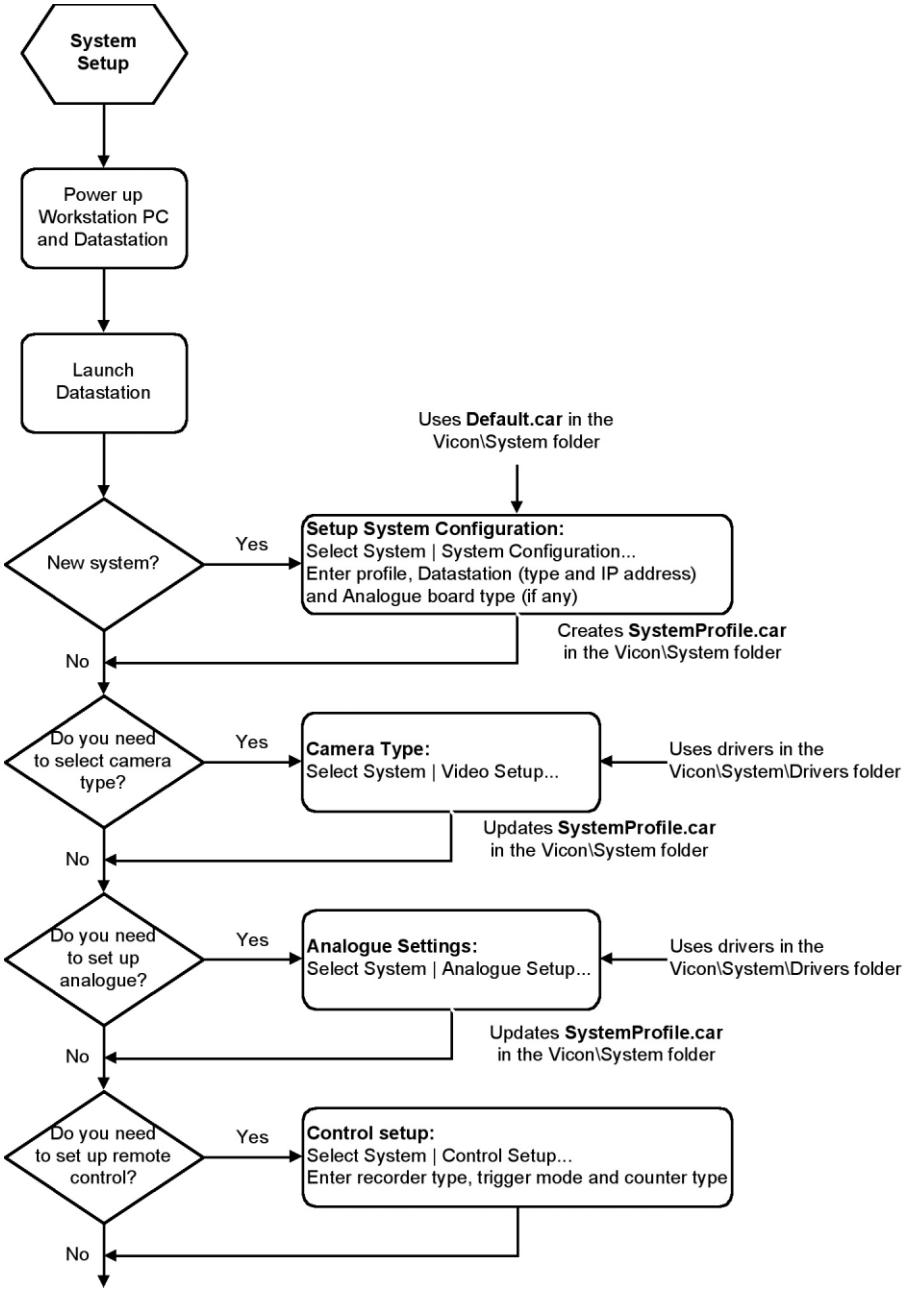
When trying to find the source of problems – poorly reconstructed data and so on – it is often a good idea to recalibrate the system and then try again. After a lengthy capture session it is also a good idea to check the calibration and to apply this calibration to some of the data. To apply a calibration to an open trial:

- Select System | Set Calibration

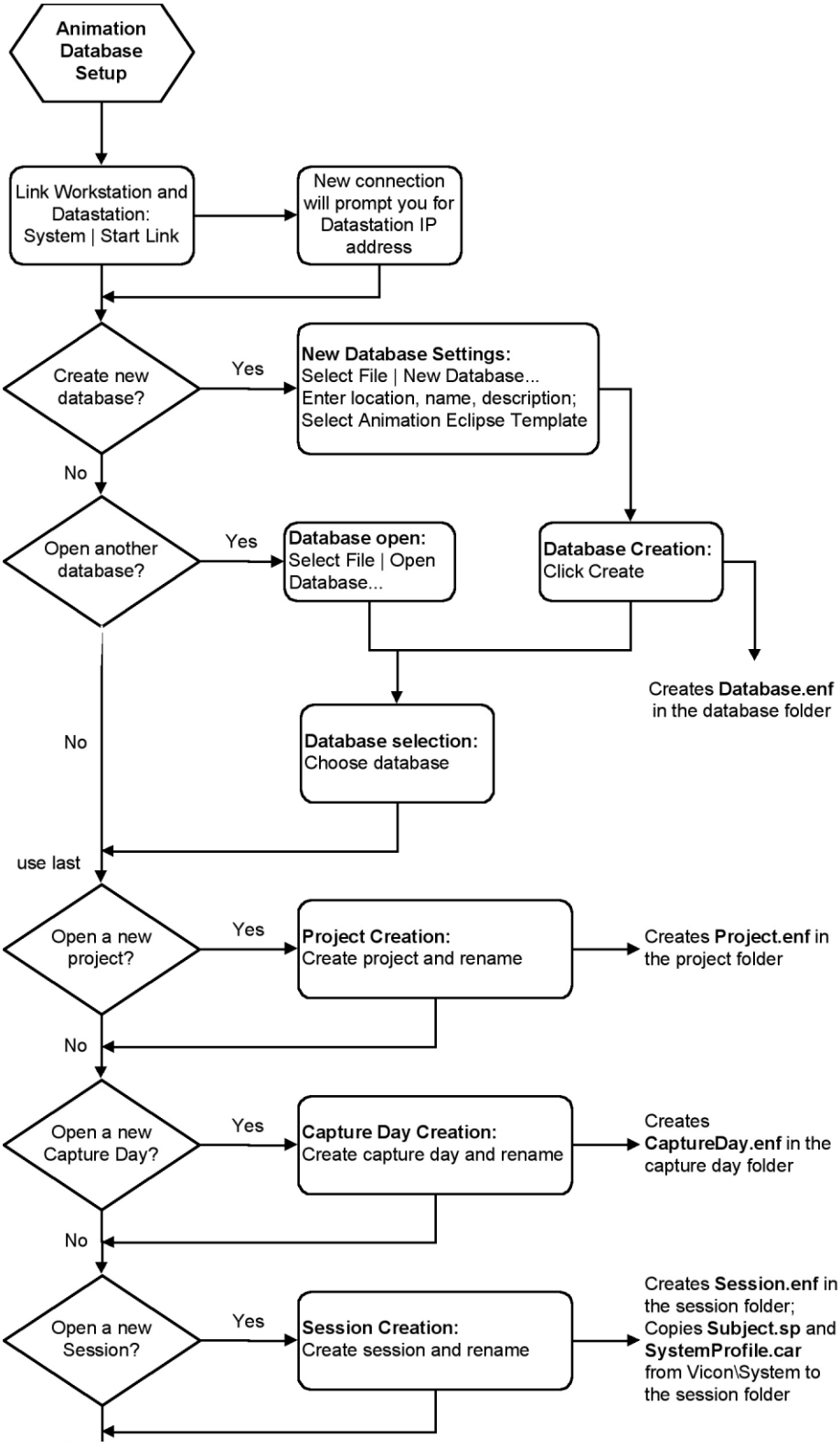
The Set Camera Calibration dialog lists calibrations (by time) created for the current session and archived. Use the radio buttons to select a list of calibrations or click Other to locate other calibrations.

- Select the calibration you wish to apply and click OK

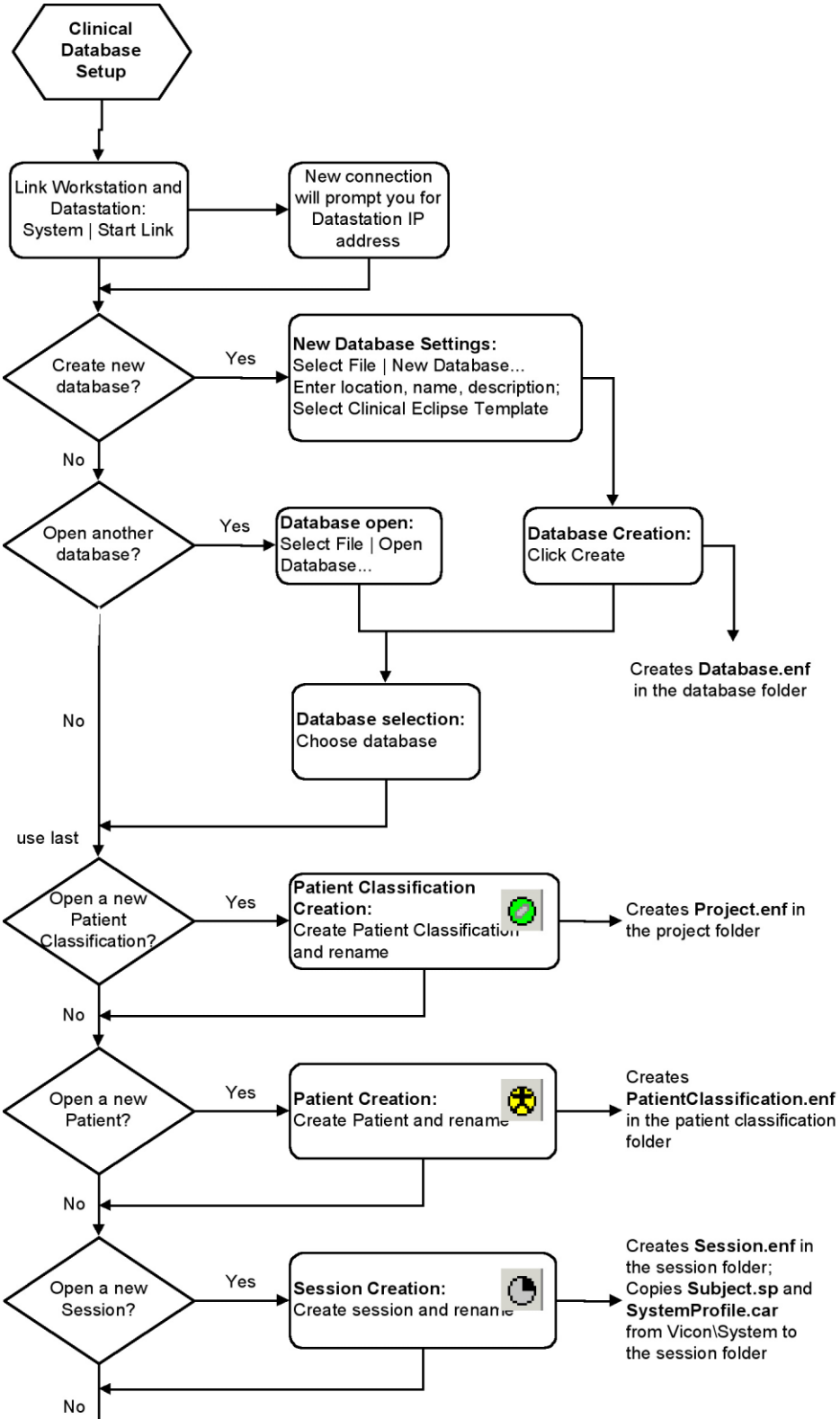
System Setup



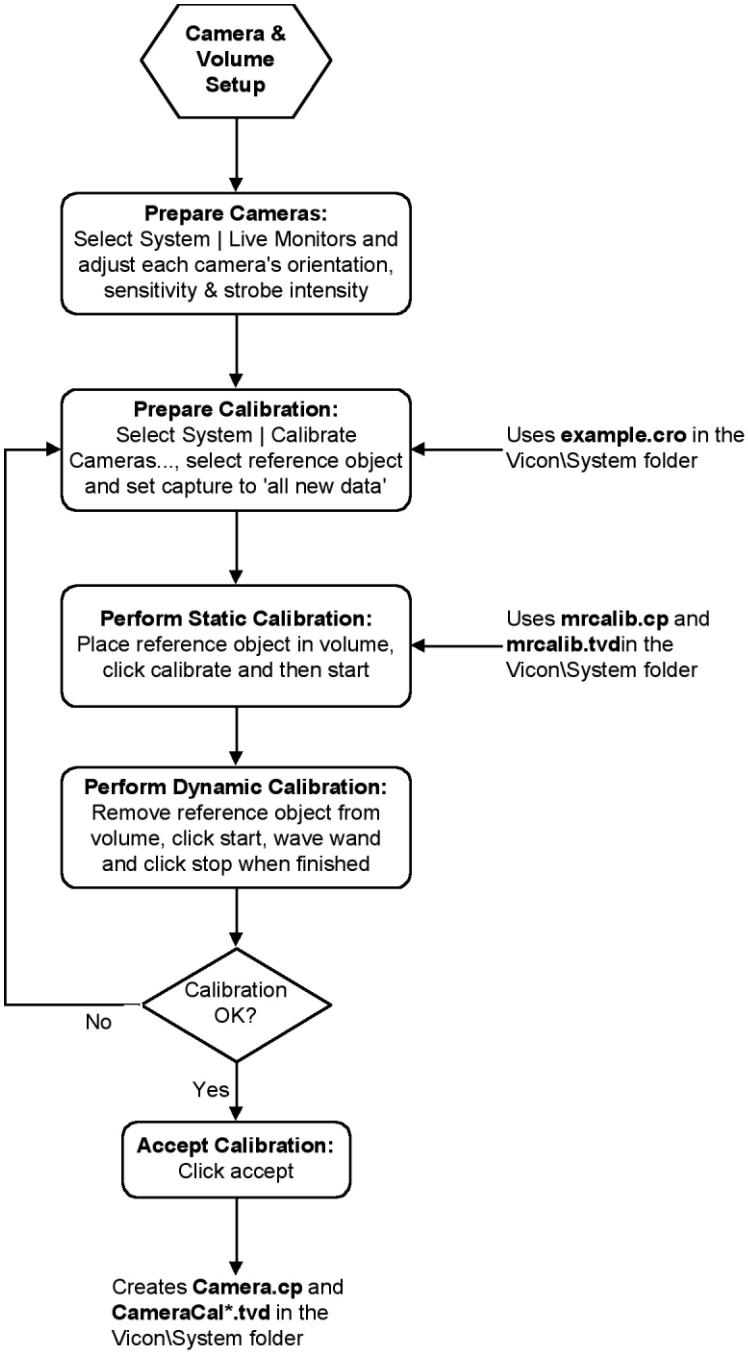
Database Setup (animation)



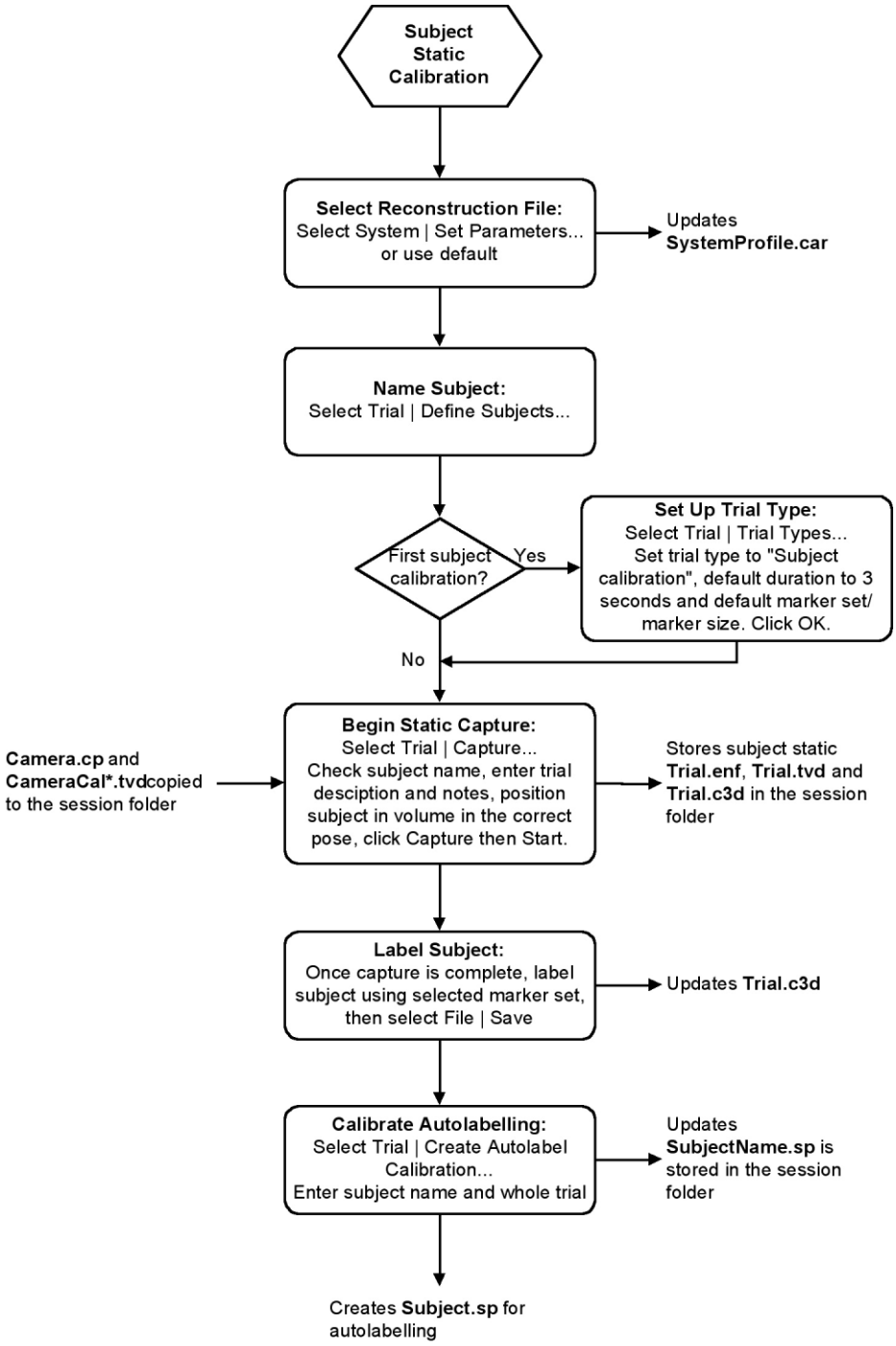
Database Setup (clinical)



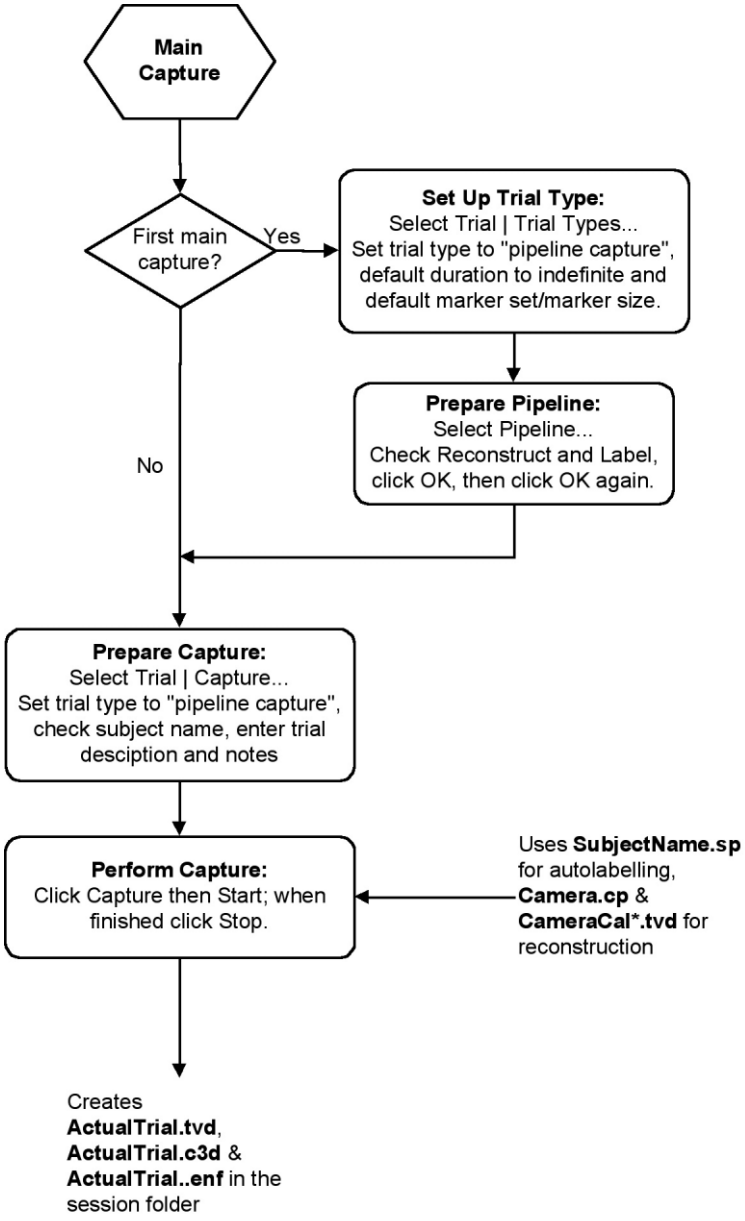
Camera & Volume Setup



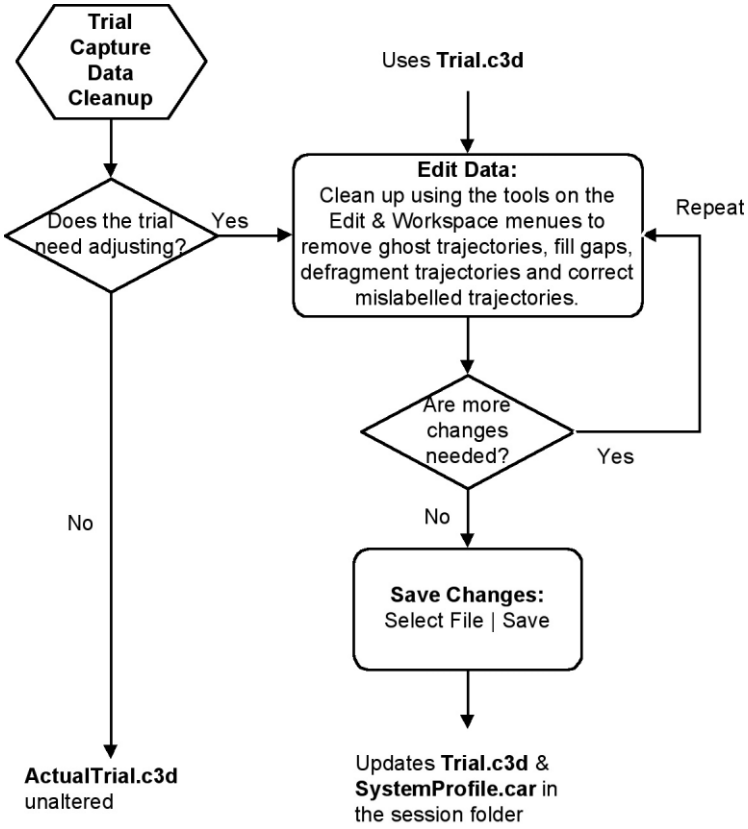
Subject Static Calibration



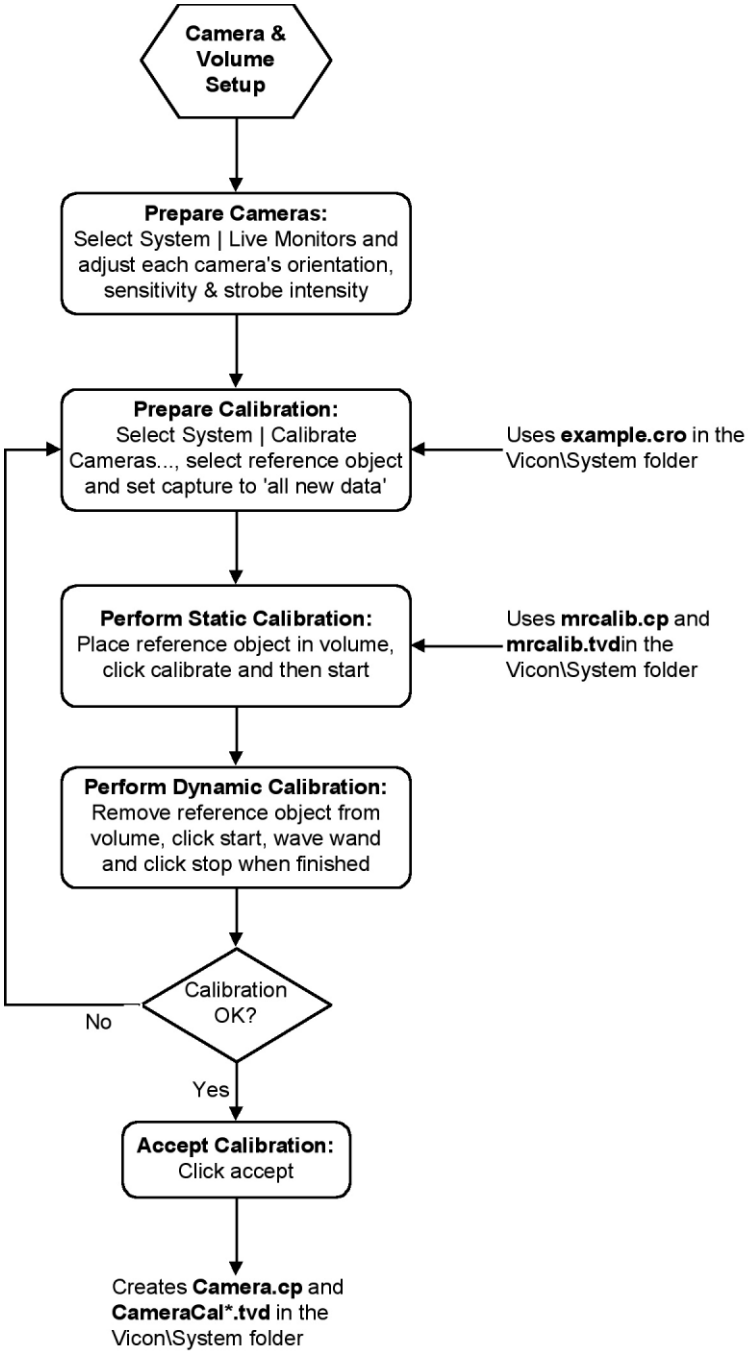
Main Capture



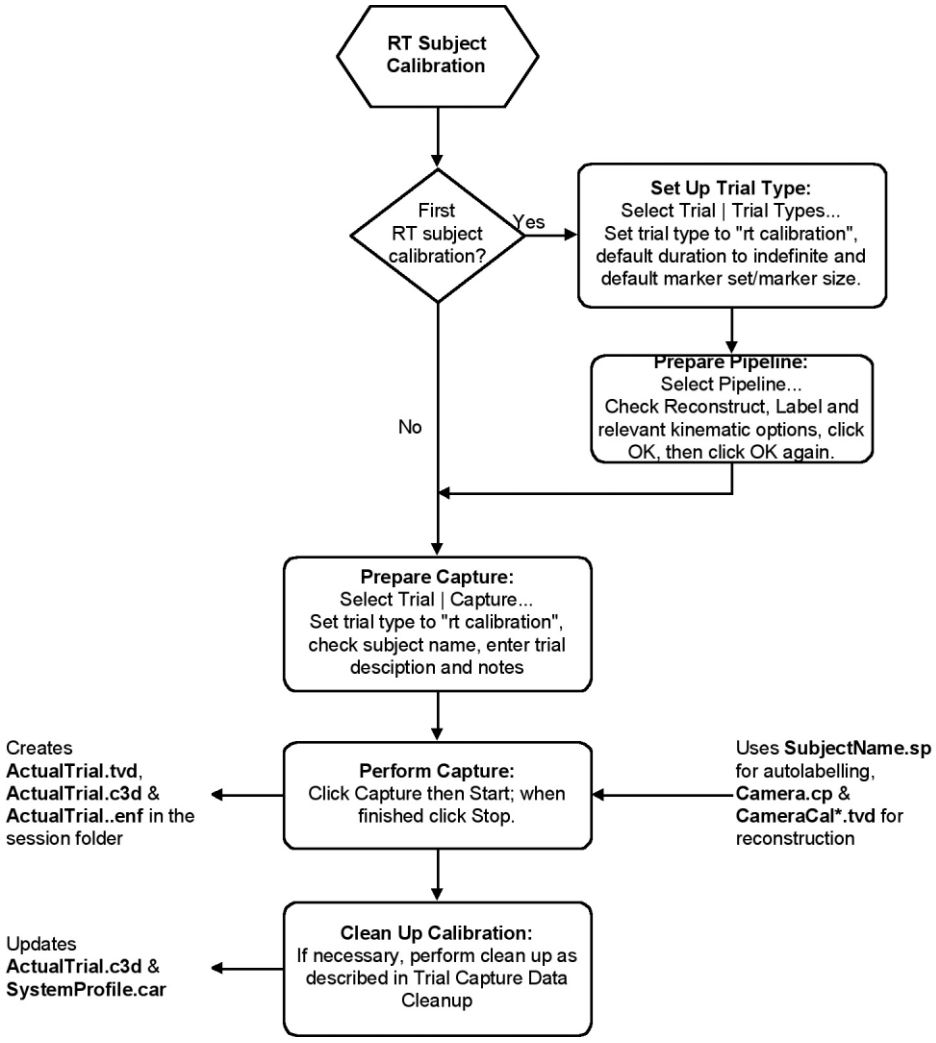
Trial Capture Data Cleanup



Real-time Setup



Real-time Subject Calibration



To manage the many files a capture produces, Workstation includes a data management system called Eclipse. Before starting to capture data you need to create an Eclipse database – a procedure completed with a few clicks of the mouse. After completing a session you can use the system to maintain your files: move them, delete them, and even add annotations.

The first section of this chapter shows you how to create a database. The remainder explains how you can use the many features of Eclipse to manage your data.

The Eclipse button

The user interface to Eclipse is called the Data Directory. If you have followed the Workstation Guided Tour then you will have already seen this window. Otherwise you can open and close it by pressing F2 or clicking the Eclipse button in the toolbar.

Creating a Data Hierarchy

Creating an empty hierarchy

You create a new database using the New Database dialog:

- Select File | New Database

You can do this even if the Data Directory is already open.

- Click '…' to the right of the Location edit box
- Use the Browse for Folder dialog to navigate to the Workstation sub-folder at:

..\Vicon\Userdata\Examples\Workstation

- Select this Workstation folder and click OK, returning to the New Database dialog
- Type a name (e.g., MyData) in the Name text box
- Enter a short description
- Under Based on select one of the templates available

In the Science and Engineering version you have the choice of Clinical or Generic Database Template. In the Entertainment version the choice is Entertainment or Generic Database template. In both cases the template files are listed with the extension .eni. The differences are only between the nomenclature of the nodes, or levels, in the hierarchy. To complete the new database:

- Click Create

You have now created a new data hierarchy. The New Database dialog closes and

is replaced by the Open Database dialog.
Finally, you open the new data hierarchy:

- Select your hierarchy in the list in the Open Database dialog
- Click Open

Creating the hierarchy structure

The levels within the hierarchy have different names depending on your version of Vicon. Nodes are similar to folders but each has its own properties and can only contain certain types of data. Also the hierarchy structure is strictly maintained. Therefore you will notice that certain toolbar buttons are only available depending on your position in the hierarchy. The nomenclature and toolbar buttons are defined below.

The icons in the toolbar create a new node at the appropriate position in the hierarchy. The icons also appear in the hierarchy itself.

Generic Database	Science and Engineering	Icon	Entertainment (V series)	Icon
Top Level	Patient Classification		Project	
Subject	Patient		Capture Day	
Session	Session		Session	
Sub-session	Sub-session		Sub-session	
Trial	Trial		Trial	
Polygon Report	Polygon Report		Not available	

Within a trial these icons indicate the type of data available. Double-clicking an icon opens that data window in Workstation. Double-clicking the trial icon, or the name of the trial opens the 3D Workspace window and, if available, a movie window.

Data Type	Icon	Notes	File Extension
Movie		MPEG format movies	*.mpg
Analogue		e.g., from Force plates	*.vad
Video		Unprocessed Video data, opens in monitor window	*.tvd
Processed		The Vicon virtual three-dimensional motion opens in Workspace window.	*.c3d

In a database you initially create a Top Level Node, followed by a New Subject and then a session:

- Click the New Top Level button
- Enter a name for the node in the highlighted text box and press Enter
- Click New Subject
- Enter a name for the Subject e.g. the name of the person being captured and press Enter
- Click the New Session button
- Enter a name for the session and click Enter

More about Eclipse

Opening and Closing Eclipse

The Data Directory has been designed to simplify Vicon Data management. As with any other file management system you can create, delete, rename and move files around your computer system. Because there are so many files associated with a Vicon trial this could get quite complicated, but Eclipse keeps all the appropriate files together.

Eclipse works in the background ensuring that your data is kept safe and in order. The user interface to the data management system is the Data Directory window. On installation the default setting is that the Data Directory opens automatically when you start Workstation. You can change this using the User preferences dialog:

- Select File | User Preferences
- Select Open Data Browser Window to always open on start up
- Clear Open Data Browser Window to start without the Data Directory

At other times you can open or close the Data Directory by any of the following means:

- Press F2
- Click the Eclipse button
- Select View | Data Directory

How the files are arranged on your hard drive

When you close all open windows or close a trial then the Data Directory opens automatically.

The data hierarchy shown in the Data Directory is mirrored with a system of folders

on your hard drive. Under no circumstances should you manually change this set of folders as this will prevent your database system from functioning correctly.

The top level folder for your hierarchy has the same name as the Eclipse database with subfolders for each node. Sub-sessions and Trials do not have their own folders but are sets of files within the Session folder. The actual hierarchy for these files is governed by a series of text files create and maintained by the Eclipse application.

Eclipse files: How Eclipse works

When you create an Eclipse database you create the folders, mentioned above, and a number of simple text files. It is these text files that the application uses to define and control the structure of the database. In general you should not edit these files (though experienced users can do so in order to customise the way Eclipse looks and works). There are three types of file:

Eclipse Node Initialisation (.eni)

These are the template files. On creation of a new database a copy of the template file is placed in the database folder. If the original template file is changed at a later date the copy, and the individual database is unaffected. If the database copy is changed then only that database will be affected.

Eclipse Node File (.enf)

Every node in the database has an associated Eclipse Node File. If you open the file in Windows Notepad you will see that it contains information about the node, the parent node, the name of the node and so on.

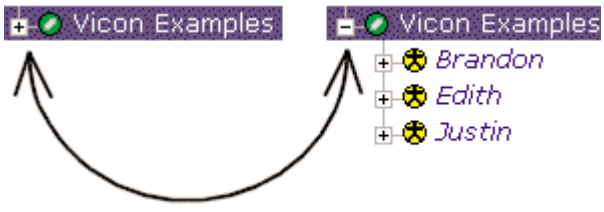
Deletion files (.end)

When a node is deleted Eclipse changes the .enf file to an .end file. This facilitates easy restoration of the node if you change your mind. The .end extension tells Eclipse that the node is no longer available for the current session. When Workstation is closed you will be prompted as to whether deletion should be completed or whether the nodes should be restored. If deletion is cancelled then the files are returned to their original status. If it is confirmed then the extension is changed back to .enf and the file moved to the Windows Recycle Bin.

Navigating the Data Directory

The hierarchy is expanded by clicking the plus sign (+) to the left of a particular node.

Expanding the Data Directory: Click the plus/minus signs to open and close the nodes



The Fully Expanded Hierarchy

It is possible to have up to five levels (plus a report for most levels) in the hierarchy. Recall, these are similar to folders but each level has different properties and contains different things. The bottom level is the Trial and this contains all of you motion capture data. Each Trial is stored in a session. If you want a finer definition you can have sub-sessions, perhaps to separate out similar sets of data. A session has certain properties, such as calibration data. Sessions are stored for each Subject. The naming convention is defined in the Eclipse template used to create the database, and can even be edited to produce different names. You will see this when you create a new database of your own.

Active and selected nodes

There are two ways of highlighting nodes; active and selected, and a node may be both active and selected.

An active node is shown with a solid background, either grey or blue. A node is made active by double-clicking anywhere in the horizontal region defined by the highlight.

A selected node is highlighted in blue but only behind the text. Select a node by clicking once.

Double-clicking makes a node active and selected. If you select another node, the active node remains highlighted in grey.

The difference between active and selected is as follows.

Active	Saves changes to data when using Workstation. Changes in Data Directory are made using the Toolbar
Selected	Changes made using the right mouse (popup) menu.

Selected Node Properties

There are many features available for a selected node – all accessed through the shortcut menu. To see this, right click a node. The shortcut menu lists the following commands.

Shortcut Menu Command	
New	Creates new nodes. Which nodes are available depends on the node currently selected.
Open	Allows you to choose the data to open within the current trial.
Edit	Depending on the node selected, allows you to edit Description, Notes or Stages.
Copy	Copies the selected node and all data within that node (including sub-Sessions) to the Eclipse internal clipboard.
Paste	Pastes nodes from the internal clipboard into the currently active node.
Batch Process	Available only for Sessions, Sub-sessions and Trials. Allows you to mark the file for batch processing.
Set Status	Only available for Trials. Allows you to mark the Processed data as: Labelled, Filtered, Modelled or Adjusted.
Delete	Deletes the currently selected node
Restore	Restores previously deleted nodes. This is only accessible from the parent node of those deleted. When you close Workstation you will be prompted to confirm a deletion or to restore those nodes. Deleted nodes may also be restored from the Recycle bin.
Empty	Confirms the deletion of nodes before you close the program.
Rename	Allows you to rename the selected node.
Select Font	Opens a font selection dialog. The font chosen will apply across the whole database system – not just the selected node.
Open Database	Brings up the Open Database dialog.

Database location

It is common to create your database in the Workstation folder at the same level as the Vicon Examples folder, but you can create it on any drive for which you have write permissions. Note that the system does not allow you to create a new folder,

so if you want to create the database in the folder at the location C:\My Vicon Data, then this must already exist or you must create it prior to creating the database through Eclipse.

Other information: Data Types

To the immediate right of the node name you will see a number of icons. These tell you, at a glance, the type of data saved in this trial. These are defined in the table above. To open a particular data type in Workstation, double-click the icon.

Other information: Discrete Data Values

Discrete Data Values or DDVs are text or numerical data associated with a node. There are three DDV fields included in the default database – shown to the right of the node name and data type icons. These are

- Description
- Notes
- Stages (Trials only)

There are two ways to edit these values:

- Select Edit from the shortcut menu and choose the DDV you wish to change or add
- Double-click in the region of the DDV

In the cases where it is a free text description a small dialog appears. If the range of values is restricted then you will be presented with a drop down selection box.

Resizing DDV columns

Place your mouse cursor just to the left of a DDV column. You will see the cursor change into a double arrow. To resize the column, click with the left mouse button and drag left or right.

Opening a Trial

To open a trial from the Data Directory double-click the trial icon or the adjacent text. By default Workstation will display reconstructed (processed) data, and if present, the associated movie file. You can open individual data files by clicking the appropriate icon. When you do this the Data Directory closes and the main Workstation window becomes active – displaying the data selected.

Creating a report

Eclipse also works with Polygon, the Vicon report and presentation application. To create a report from the Data Directory:

- Select a node for which you want to create a report

New Report

- Click the New Report button
- Enter a name for the report in the text box and click Enter
- Double-click the report node

This starts the Polygon application.

Moving Nodes: Dragging

Analogous to moving folders and files in Windows, this is achieved by clicking ad dragging the node to another location. The rules of the hierarchy still apply so that you can only move a node into a valid parent node. As you drag the node the cursor changes to a barred circle until you pass over a suitable parent node when it changes into a pointer with a box underneath.

Another restriction is that if a node does not have its own folder on the hard drive then you cannot move it into another folder. For example Trials are sets of individual files within a folder defining a session. Therefore you cannot move a trial into another session. The exception to this rule is if the trial is in a sub-session. Sub-sessions do not have their own folder; they are merely references to sets of trials. Visually this can make file handling easier if you have many trials within a session.

Moving Nodes: Copy and Paste

You can copy and paste nodes and all their associated data. You can copy a node to any location within the current hierarchy or you can close this and copy it into another hierarchy. When you copy the system uses an internal clipboard and not the main Windows clipboard. Note that the same restrictions on the data hierarchy as when you move nodes apply. To copy a node:

- Select a node
- Select Copy from the shortcut (right mouse button) menu
- Select the node where you wish to paste
- Select Paste from the shortcut menu

3
3D Workspace
    functions 6

A
Analogue 8
Analogue Data
    window 7
Aperture 8
Autolabel 8
    failure 26

B
Blooming 8
BOB 8
BodyBuilder 8
BodyLanguage 8
Burn-in window 8

C
C3D 8
Calibration
Cameras 8
Object 8
    residuals too high 21
    static subject 31
    subject 13
    Subject 8
    Volume 8
Camera & Volume Setup 30
Camera and Volume
    setup 30
Camera Interface Unit 8
Capture 32
    space 8
    volume 8
Capture Day
    icon 4
Capture Volume 12
CG Plug-ins 09
Cleanup
    trisl data 33
Context 9
Context Bar 9
Create
    data hierarchy 37

D
Data Directory
buttons 5
view 25
Data files
how they are stored 38
Data Quality 26
Data rate 19
Data Type
icons 6
Database Setup
animation 28
clinical 29
Datastation 9
Defragment 9
Depth of Field 9
Display
defining in marker set 16
Dongle 9
DynaCal 9

E
EBU 9
Eclipse 9
buttons and icons 5
using 36
Eclipse files 39
Event 9
Extension
file 13

F
failed calibration 22
Field 9
File Types 13
Files
storage hierarchy 38
Flipping 24
Flow Charts 27
Frame 09

G
Gait Analysis 9
GenLock 10
Glossary 8
Gmarkers 24

I
Interpolation 10

Inverse Kinematics 10
Iris10

K
Kinematic Model 10

L
Label 10
Linearisation 10
Linkage List 16
Live monitor 21

M
Marker 10
Marker Set 10
    creating and modifying 15
Mobius 10
Motorcycle Pose 10

N
Navigating
Eclipse 39
Node
    moving 43

O
Online Help
    enabling and using 18
Open
    Ecipse 25

P
Patient
    icon 3
Pipeline 10
Plug-ins 10
    CG 9
Polygon 10
Pose
    motorcycle 10
Post-Triggering 11
Preferences 11
Problem Solving 18

R
Real-time
    setup 34
    subject calibration 35
Reconstruction 11

volume 11
Root 11

S
Sample Skip 11
Segment 11
definition list 16
linkage list 16
Select trajectories
problems 23
animation database 28
clinical database 29
Real-time 34
SMPTE 11
Spike 11
Static Trial 11
Strobe 20
Subject
icon 5
Subject Calibration 11
R-time 35
Sub-session
icon 5
Support
online 18
System Setup
flow chart 27

T
Time Bar 11
gait analysis 5
general 4
Timecode 11
Toolbars 3
Top Level
icons 5
Trajectory 12
flipping 24
not reconstructing 25
Trial 12
icon 5
static 11
TVD 12

V
Video
data 12
Video burn-in 12
Video Monitor

window 7
Volume 12

W
Wand 12
Window
Video monitor 7
Wndow
analogue data 7
Workspace 12
Workstation 12