

Recipe for Motion Capture

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Overview

The Vicon 8 optical motion capture system was specifically designed for animation. The system has the capacity to hold 24 cameras. At the MoCap Lab we have 14 cameras. Up to 24 hours of motion capture is now possible at one time. There is enough memory in the Datastation and enough disk space to accomplish this task. The system includes SMPTE and genlock, which can allow it to integrate into a studio system. Triggering devices allow simultaneous recording of video to match the motion capture data frame by frame.

This document is a step-by-step tutorial for capturing, cleaning and exporting your data into various formats as well as other software packages. We have also purchased the Realtime option for our system, which allows the director to view the performance live while it is being captured.

Section 1 discusses the equipment used in the lab. Section 3 covers logging in and the different files associated with motion capture. The cameras are then calibrated in Section 4 and data is captured in Section 5. Section 6 deals with cleaning the data and exporting. Advanced topics such as batch processing, different marker sets, capturing multiple subject performances, facial capture, and Realtime are covered in Section 7.

After becoming familiar with this material, I strongly suggest you read through Vicon's hardware and software manuals. This document is to be used only as a starting point to get you capturing and using your data.

Section 1: Equipment

The equipment consists of:

- Software
 - Vicon 8:
 - Workstation 3.7 Build 074
 - Bodybuilder 3.53 Build 129
 - Realtime Engine 1.0 014
 - Kaydara: FiLMBOX 3.0
 - House of Moves:
 - Diva
 - Dominatrix
 - Alias/Wavefront: Maya 4.0
 - Lifeforms Dance 3.9
 - SideEffects: Houdini v 9.x
 - 3D Studio Max 4.0 with Character Studio 3.0
- Hardware
 - Cameras
 - Tripods
 - Break-out-boxes
 - Datastation
 - NT 4.0 machines
- Miscellaneous
 - Body suits
 - Markers
 - L-frame and wand
 - Toupee tape
 - Velcro
 - Wrist and head bands
 - Shoes

Software

The software platforms will be discussed in detail individually, throughout the rest of this document. A brief explanation of the purpose of each software package in the motion capture pipeline is given here.

The calibration of the cameras, data capture of the 2D marker positions by the cameras, reconstruction of these markers in 3D, labeling of the markers and initial cleaning of the marker trajectory data is carried out by Vicon's Workstation software. In addition, realtime capture is also done in conjunction with Vicon's Realtime engine and either one of the animation packages Maya 4.0 or FiLMBOX.

The data then needs to be further cleaned and a skeleton needs to be created from the marker data, which can be done either by Bodybuilder or Diva. Bodybuilder is more a biomechanics software package and is mainly used when the skeleton joint trajectories

are going to be examined for research purposes. Bodybuilder has a scripting language that allows us to accurately place skeletal joint position with respect to marker placement.

Diva is more an animation tool and has a Maya interface feel to it. It has a scripting language which allows us to write cleaning scripts. It also lets us create both human and non-human skeletons.

Once skeletal information has been added, the data can be imported into Maya, FiLMBOX, and Lifeforms Dance. To import motion capture data into Maya, the Dominatrix plugin is used. It is also possible to import the marker data directly into Maya and FiLMBOX. Maya can do this either using the Dominatrix plugin or by using Vicon's beta format under development, called the .v format. I highly recommend that you try to avoid the .v format as we have had numerous problems with it. One of the reasons we now have the Dominatrix plugin.

Hardware

We have fourteen M-CAM (60) 250Hz progressive scan cameras which are positioned about the room using a combination of tripods, wall mounts 12 feet off the ground, and clamps attached to a grid structure, 16 feet off the ground.



The cameras have 12.5mm cosmicar lenses. The cameras have a resolution of 1000x1000 pixels, non-interlaced.

For most sessions the fstop, which is the iris aperture on the lens, is set to 1.4. The aperture is widest when set to the smallest number. The control knob on the back of camera is set to any non-zero value. The zero setting is a hardware mode, to be used if there is a problem with a camera. Red strobes are mounted around the lens, magnetically attached. This reduces the specular glare.



Three cameras are connected to each breakout box (b-o-b) through video and power cables. Each b-o-b is then connected to a computer developed by Vicon, called the Datastation. The boxes are connected through ports, eight of them, in the front panel of

Datastation. The cameras are identified by an ordinal number, 1 through 24, assigned by which port the b-o-b is connected. If the b-o-b is connected through the left-most port, the cameras connected to that b-o-b are numbered one through three. The cameras connected through the b-o-b in the second port, are numbered four through six, and so on, for a maximum of 24 cameras connected to Datastation. The numbers on each camera do not have any relevance to the numbering in the application software Workstation.

The Datastation is connected to the PC's through a network hub (Figure with our machine setup similar to p. 23).

The Datastation and the three PC's, running Windows NT 4.0, make up the processing component of the lab. They are connected through a network switch. It is preferable that no network software be running on these machines as they interrupt the processes which need a lot of compute cycles. The machines are listed here by name, IP address and function:

Clark, 128.146.18.13, 1GHz processor, runs Realtime (shortcut called Tarsas), Workstation, and Bodybuilder.

Strike, 128.146.18.89, 933MHz processor, runs Workstation and Bodybuilder

Thinice, 128.146.18.39, 933 MHz processor, runs FiLMBOX and Maya 4.0.

Anvil, 128.146.18.183, is Datastation and must be connected to the other machines in the Workgroup.

Miscellaneous

In addition to hardware and software, we have four body suits of various sizes that have been stitched with Velcro patches. Markers of various sizes may be attached to the suits, through sticky backs of velcro, or directly to the skin, with the use of toupee tape. The sizes of the reflective markers vary from 28mm., 14mm., 12mm., and the smallest, 6mm. These markers may be hard or soft. What and who is to be captured determine the size and type of markers to be used. The smallest markers are used when clusters of markers are used closely together, like hand and facial captures. The soft markers are used if the person is going to have a lot of body contact with the floor. We have had great success with 14mm. hard markers for the body motion capture.

Section 2: Logging in

Starting the system involves starting Datastation and logging into the other three machines. Pressing the large silver button on the front panel starts Datastation. The red strobe lights on the cameras will illuminate, and eventually, messages on the front panel of Anvil will scroll. Each PC has only two users registered, the administrator and the user “mocap”. Log onto each machine as mocap. On Clark, Tarsas will start up immediately. This is the realtime application. On Strike, dbl-click the Workstation icon.

A login window will pop up asking for a username and password. If this is your first time using the system, type in a username for yourself. If it’s a new one it will ask you if you would like to create a new user. Click on Yes and if you want you can enter a password although most users don’t use one. There is also an entry box for the data path. By default the path will be set to C:/VICON/USERDATA/LOGINNAME If you are planning on working on data that has already been captured in another session, you can change the directory name to point to that session. If you need to change the data path later you can do so by going into the <File> menu and selecting <User Preferences>. [From this point, menu selections will be denoted <File>/<User Preferences>.]

Once the Workstation main window has opened you will see a Directory window showing your Data path and any sessions that may have already been created.

Select <System>/<Start Link>.] This will connect Workstation to Datastation. Similarly the selection <System>/<Live Monitors> will make the same connection and bring up a window of the camera views. This must be done at least 10 minutes before a capture. It allows the cameras to warm up before a capture.

For our lab, the buttons on the bottom of the window should read 1 through 18, 1 through 14 are the only active selections. Leaf through the different camera views and make sure that nothing appears, either exposed markers or bright reflections. Markers and reflections should be concealed. If this is not possible, mask the reflection with dark masking tape.



Figure 1: Live Cameras window

Leafing through the camera views is accomplished by clicking on the individual numbers in the bottom bar, or by clicking on the up/down arrows.



Figure 2: Camera Buttons

Motion Capture Files

A brief description of the file types associated with motion capture is given below.

- .tvd – raw video data captured by the cameras
- .c3d – 3D reconstructed data created by the system using .tvd
- .mkr – marker file which defines the marker set being used in the capture
- .ses – session file
- .sp – subject parameter file
- .cro – calibration object definition file
- .car -
- .cp – camera parameters file
- .asf – acclaim skeleton file
- .amc – acclaim motion file
- .bvh – biovision file

Section 3: Calibration

Calibration is the process of defining what each camera sees and their relationship in physical space with each other.

In our system, calibration consists of two steps: static calibration and dynamic calibration. Static calibration involves allowing all the cameras to see a static calibration object, the L-frame, in the capture space. Dynamic calibration involves waving a 500mm wand throughout the capture volume and making sure all the cameras have a chance to see the wand in various parts of the capture volume. Together, the static and dynamic calibrations allow for calibration of the cameras with respect to the capture volume.

Place the L-frame in the exact center of the capture volume. Make sure the L-frame has not been leveled but lies flat on the floor, since the floor might have a slant and we don't want markers to start going through the floor. The placement of the L-frame determines the X and Y axes of the space. The corner of the L-frame is the origin and should be placed in the center of the capture space. The side of the L-frame with two markers at the end is the X-axis. Positive X is away from the origin marker and towards the two markers. The other side of the L-frame represents the Y-axis with positive Y in the direction from the origin towards the single marker. The positive Z-axis points up (Figure). Click through all the camera views. Make sure you can see **only** the L-frame in every view.



Figure 3: Static L-Frame in Live Monitor

(You might also see an opposite camera, depending on camera configuration. This will be okay. It will be removed during dynamic calibration, with the wand.) A window will pop forward from the menu selection **<System>/<Calibrate>**:

1. Make sure all fourteen cameras are selected with a check in each box. If all fifteen are selected it doesn't matter (Fig. 5).

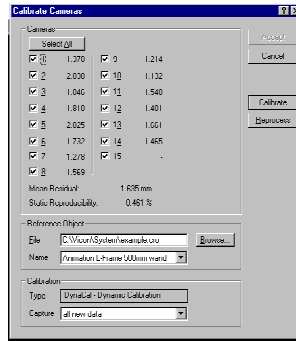


Figure 4: Calibrate Cameras Window

2. **Don't** change the File reference object, "example.cro". This file defines the calibration objects that came with the system (like the distance between markers on the L-frame).
3. The "**Lframe 500 mm wand**" option will generally be used. The only other choice we have is "**flatcal 100mm wand**", which is used for facial capture.
4. Make sure that in the Calibration portion of the window, "**Capture: all new data**" is selected. This will take you through the static and dynamic calibrations. If a problem occurs with residuals and you want to do the dynamic calibration again, change the selection to "**Capture: dynamic data only**". This will combine the previous static calibration with the new dynamic calibration. Similarly if you're interested in repeating static calibration, you could select "**Capture:static data only.**"
5. Press [**calibrate**] button.
6. A smaller dialog pops forward with the word "**Static**" on top. Press the button, [**Start**]. This process will save 20 frames of the L-frame for static calibration. And upon completion will revert to the window with the [**Start**] button, this time for dynamic calibration.
7. For the dynamic calibration the 500 mm wand must be swept through the desired capture volume. The important item to remember is to minimize the time that the wand is collinear, or pointed straight, with each camera and to cover as much of the volume as possible for each camera.
8. After some calculation, the results will be displayed in the Calibrate Cameras window. The residuals for each camera should be less than 2.0 mm, with a very few over 2.0, and no cameras should show a residual greater than 3.0. The Mean Residual must be less that 1.0, the lower the better. We've been getting a *Static Reproducibility error* of less than .60% and as low as .10%. The dynamic calibration should be repeated if any camera has a residual over 3.5. Both the linearization (correcting for lens imperfections) and calibration are done during dynamic process.
9. Hit [**accept**] if residuals are okay. Make sure you have residuals on all 14 cameras. If there is no residual for any of the cameras in use, then those cameras are not seeing

either the static or dynamic calibration objects. The camera(s) will have to be manually positioned to see the volume.

If there are calibration problems, start with the dynamic calibration and redo the wand capture. Make sure there are no extra markers in any of the cameras' views. If the problem persists, an analysis of the .tvd files (video data) may be necessary.

To look at the volume of the performance space, select **<Workspace>/<Volume Visualization>**. Select the x, y, and z contour slices and press **[Ok]**. The reconstruction window will show you the volume of the capture space.

Section 4: Capture

The capture process consists of creating a new session and applying the recent calibration to it. We then marker the person and/or props and run a subject capture. After which all the trials, that is the actual data you would like to have, can be captured.

Starting a session

You can create a new session by going to **<File>/<New session>**.

Enter a reference name and select the box next to **“Use most recent calibration”**. It doesn't matter who was logged in when the calibration was done. The system will automatically apply the most recent calibration. Make sure the session folder in which the trial is to be placed is open (in case you didn't just start a new session and have been moving through different sessions in the data directory). The folder icon appears yellow in the Workstation window and has a little blue, quarter-circle icon, inside. The line entry for the folder will be highlighted in gray.

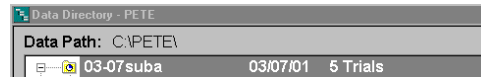


Figure 5: Active Session Folder

It's also possible to create your new session folder and then do the calibration step. At the end of calibration, it will ask you if would like to apply the calibration to the current session.

Markering

If you have a human subject, you can marker the person using the standard 41-marker set that Vicon defines. Look at p. 70-77 in the Vicon manual for marker placement. The 41-marker set is defined in a Marker Placement File. This type of file will have an .mkr extension. The default marker file is HumanRTKm.mkr. This file specifies the marker labels, the green stick links between the markers, the labels that identify body segments, and the links between body segments.

If you would like to have more markers than the 41-marker pre-defined set or need to create a marker file for a prop, you will need to modify the .mkr file. This will be covered in detail in Section 6.

Subject Calibration

Then from the menu bar select **<Trial>/<Capture>**

In the subsequent window, scroll and select **“Subject Calibration”**. Press the **[Types]** button.

Make sure that the entry for **marker set** is *HumanRTKm.mkr*. Then select **[Pipeline]**. Make sure the boxes next to **“Reconstruct”** and **“Save”** have been selected. Select **[OK]**.

Enter a description that will be indicative of the session. Press the [**Capture**] button. The Performer takes the “moto”, motorcycle pose. [**Start**]. Capture will automatically stop and reconstruct the pose.

Create Autolabel Calibration

Scrub the timeline until all markers are visible. You can translate, rotate, and zoom the view using the mouse buttons LMB, RMB, both LMB and RMB respectively. Now it is time to label the markers. This process takes time to learn, but may be executed in a short time with practice. Be deliberate as this is an essential component of having successful capture sessions. First confirm that the correct marker set is associated with the subject calibration. On the right side panel at the top, you should see the name of the marker file, for example *HumanRTKm*, as in Figure . If it doesn't, go to <**Trial**>/<**Attach Marker Set**> and select the correct marker file from C:/Vicon/Models. Next, we are going to hand label a single frame in the subject calibration and then have the software learn the labeling and automatically label the entire frame sequence.

1. Click on points in the image (LMB). The first marker you select will turn yellow, the second red, etc. The yellow marker is hard to see. It cycles through 5 colors and then repeats.
2. In the same order, on the right hand side of the window, click on the labels (LMB) (if the labels are in order, you can click the first label and use the down/up arrow keys). You have to select the labels in the same order that you selected the markers. You will notice that as you select a label a number '1' appears next to it indicating that one marker has been assigned to that label (see Figure).
3. If you make a mistake clicking in the image, use the RMB to unselect the marker(s).
4. If you make a mistake labeling, select the point in the image that has been mislabeled and hit the [**unlabel**] button (bottom right hand side).
5. Note: LWRA, RWRA are the wrist points for left and right hands, respectively, where the A stands for thumb side of the wrist.
6. When you are finished every label should have a '1' next to it. The HumanRTKm marker set should have 41 markers.

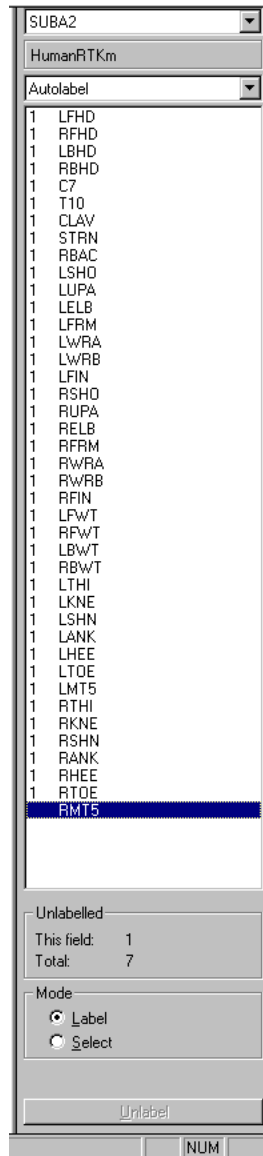


Figure 6: Label window

After the labeling is completed, select **<Trial>/<Create autolabel calibration>**. Enter a name for the **“subject”** field. Make sure there are enough consistent frames before and after the current frame, where all markers are visible in those frames. For example, if 15 is entered in the Field Range there should be 15 consistent frames of the static pose before and after the current frame, where all markers are visible in those frames. This step creates a .sp file for the subject.

<File>/<Save>. To check whether the software has learned the autolabeling process correctly, delete the hand labeling **<Edit>/<Unlabels all trajectories>**.

There will no longer be a number next to the labels on the right side panel. Now, we’re going to have the software label all the markers for the entire sequence. Go to

<Trial>/<Options>. Select the autolabel calibration subject by clicking in the box to the left of the subject name. This is the subject that you created during the create autolabel process (Figure 7). Press [OK].

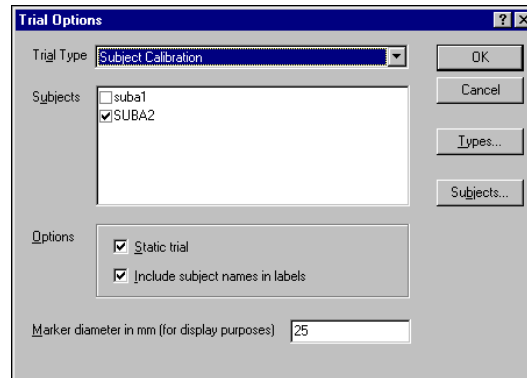


Figure 7: Trial Options Window

You should see your subject name in the right side panel at the top now. Now select <Trial>/<Autolabel>. The software will label all the markers in the entire sequence. With the mouse, slide the cursor over each marker, and verify that the correct label appears in a bubble displayed next to the cursor. When you look at the labels, in the right side panel you may see a number greater than 1 next to some of the labels. During the capture some of the markers might have popped in and out. For example, instead of seeing a single LFHD marker, the system might have seen 5 marker trajectories all in the correct position for the LFHD and so it labeled all 5 trajectories as LFHD and you would then see a 5 next to the label LFHD. These 5 marker trajectories need to be combined into a single trajectory. Also, any ghost markers that pop in and out will need to be removed. You will learn how to do this in Section 5. Now scrub the timeline to make sure that labeling was correct for the entire sequence.

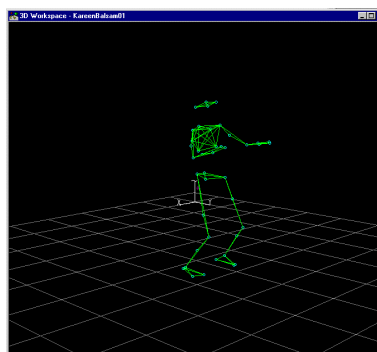


Figure 8: Labeled Moto Pose

If you look in the directory window now, you will see under the current session a trial labeled as subject calibration. The trial will have a blue and green circle in front of it. The blue circle with the V in it stands for video data. Indicating that the data has been captured for this trial and can be found in a filename with a .tvd extension. The green

circle with the P in it stands for the reconstructed data. Since that trial has been reconstructed and saved, we now have a file with extension .c3d corresponding to the reconstructed marker data. You can open either the video data or the reconstructed data by double clicking on the blue or green circles respectively.

T-pose and range of motion

It's worthwhile to have the subject go through a T-pose and range of motion, ROM. The T-pose is mainly used by FiLMBOX or for creating a 'v' formatted file for import into Maya, but it will also be useful whenever the marker data is mapped to a skeleton. In particular, you must have a T-pose for realtime. It only takes a few minutes. You capture T-pose and range of motion as a general capture. Select <Trial>/<Capture>, select "General Capture" as trial type. Select [Types]; make sure the default marker set is still "HumanRTKm.mkr". Then select [Pipeline]. Select the boxes next to "Reconstruct", "Label", and "Save Trial".

Enter a description, and press [Capture]. A dialogue will pop forward, with the [Start] button.

Actor should take the "T" pose, arms horizontal, and palms down. Press [Start]. Subject should rotate arms at wrists, elbows, and shoulders. Rotate head, legs at all joints, at the waist, crouch and get up. The idea here is to show all possible joint rotations. In addition, after going through these steps the subject should go through a few motions that mimic the action that will subsequently be performed. For example, if a person is interested in capturing golf swings, have the subject pretend to hit a couple of golf balls. Similarly, for dancers, have them go through some of their more extreme motions in their performance. The system needs to get an idea of the full range of motions that the person is capable of. Hit the [Stop] button.

General motion capture

This is similar to the steps you go through for the T-pose

- 1) Select <Trial>/<Capture>
 - a) <Trial type>General capture
 - b) [Types]: default marker set is **HumanRTKm.mkr**
 - c) [Pipeline]: default options should be checked, "Reconstruct", "Label", and "Save Trial".
 - d) Enter a description
 - e) Select [Capture] then [Start]. The session is being captured.
 - f) The trial is terminated by selecting the button [Stop].
- 2) With **3D reconstruction** and **autolabeling** selected in the pipeline, the session will automatically start reconstructing and autolabeling once the [Stop] button is pressed.

Repeated Motion Capture

If there are a number of sessions to capture, instead of "General capture", use "Repeated capture" for Trial types. This will delay the reconstruction phase until the end. The process is similar to the General Motion Capture except 1 (c). In the Pipeline window, only "Save Trial" should be checked. On processing the [Stop] button, it will

automatically go back to the Capture window for the next capture. After all the captures are completed, you will have to reconstruct and label these trials.

During a capture session, it's best to reconstruct and label one or two short trials to confirm that there are no problems with the capturing. If you don't have any short trials, run a quick three-second capture and reconstruct and label that.

Section 5: Cleaning Data

Before starting this Section you need to have processed your Subject Calibration moto pose. If you haven't go to Section 4: Create Autolabel Calibration first. If your data has already been reconstructed and labeled (whether it's your moto pose or some other trial) and you just need to clean it, proceed to step 1 below.

Otherwise, you will need to reconstruct and label your data before you can start cleaning.

Open the trial that you wish to work on by double-clicking on the blue circle. Now select **<Trial>/<Reconstruct>**. This will reconstruct the data. You will see in the bottom left part of the window information on the status of the reconstruction. **<File>/<Save>**. If you look in the directory window now, you will see a green circle appear next to this trial indicating that this trial has been reconstructed.

The next step is Autolabeling. First check that the correct marker file is associated with this data. The upper right corner should have the name of the marker file (*Figure 6*). If it doesn't, go to **<Trial>/<Attach Marker Set>** and select the correct marker file. Go to **<Trial>/<Options>**. Select the autolabel calibration subject by clicking in the box to the left of the subject name (*Figure 7*). This is the subject that you created during the create autolabel process in the subject calibration trial. Now select **<Trial>/<Autolabel>**. You will see in the bottom left of the window the status of the autolabeling process.

Once the trial has been reconstructed and autolabeled, we can begin cleaning the data. Once you are familiar with this process it will be worthwhile to look at Section 6 on Batch Processing which will save you a lot of time on the reconstruction and labeling steps.

- 1) Open one of the reconstructed trials by double-clicking on the green circle. The first step is to make sure all the markers that are part of the body have been correctly labeled. This does not mean that every single marker that you see on scrubbing the timebar will be labeled. In general, you should see most of the body completely labeled. Once in a while a point might disappear and ghost markers might flash in and out. That's okay. We'll be fixing that. If though, when scrubbing the timebar you notice that a part of the body, e.g. left leg, has not been labeled at all, hand label those points that have not been labeled in one of the frames and then press **<Trial>/<Autolabel>** (*Figure*). The software should now have correctly labeled all the markers. If not, repeat the above step.
- 2) The next step is to fix any swaps that may have occurred in the data. A swap may occur when two markers come close together during a performance. For example, let's say the left hand comes really close to the right hand during the performance. For a moment, the cameras believe that the LWRA marker and RWRB marker occupy the same point in space. When the hands separate the two markers should now separate. Unfortunately, sometimes the system can't tell which marker is which. So, the trajectory of LWRA will start correctly and then all of a sudden it followed the trajectory of RWRB. One very obvious symptom is taffy like green

- strings. We have to go in by hand and snip the trajectory at the point where the LWRA marker becomes the RWRB marker. After snipping we then re-label the trajectory after the snip to RWRB. Later, I'll explain how to label the unlabeled markers.
- a) Using the step forward/backward buttons in the timeline go to the point in time where the marker just begins to move as if it were the RWRB marker.
 - b) Select the marker in this particular frame. This is the point where the trajectory will be snipped. Press **<Edit>/<Snip Trajectory>**.
 - c) Now step forward a couple of frames and select the marker again. Unlabel the marker. Select the marker again and label it as RWRB.
 - d) Repeat steps a-c for all swaps.
- 3) Now, select **<Edit>/<Defragment Trajectories>**. A window will pop up with a message. If you get the correct number of trajectories, as in 41 for HumanRT.kmt. The message will read "x joins made out of y trajectories forming 41 trajectories". Otherwise you will get a message like this: "x joins made in y trajectories forming z trajectories" where z is a number greater than 41 (*Figure 9*). In the next step, you will have to look at the unlabeled trajectories. If you get the correct number, proceed to Step (7).

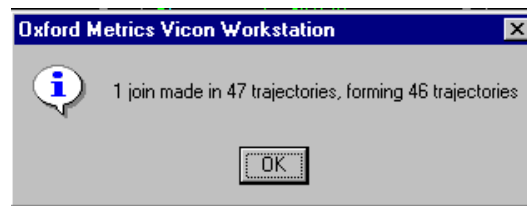


Figure 9: Defragment Trajectories

- 4) Select **<Window>/<New continuity Chart>** (*Figure 10*). Scroll down the chart as well as to the right looking for any trajectories with the word Unlabeled.
 - a) You can delete any unlabeled trajectories that are too short to have any worthwhile data. Select all short unlabeled trajectories by using the LMB on the lines in the area below the labels.
 - b) Select **<Edit>/<Delete Multiple Trajectories>**. **IMPORTANT: Do not choose <Edit>/<Delete unlabeled trajectories>**. This will delete all the trajectories that are still left unlabeled.
 - c) Now select any unlabeled trajectory that you think might have useful data.
 - d) Scrub the timeline bar until the timeline is crossing the unlabeled trajectory you just selected (*Figure 10*).
 - e) Now look at the viewing window. You should see a yellow marker. If this is a marker that belongs to the body, label it. Otherwise, use **<Edit>/<Delete trajectory: Unlabeled>**. Note that the Delete option under the Edit menu keeps changing its name based on what marker(s) you have selected.
 - f) Repeat steps c-e for all the unlabeled trajectories.
- 5) Repeat **<Edit>/<Defragment Trajectories>**. If it still doesn't say 41, you need to continue to look in the Continuity Chart to see what's left. At this point, all the

unlabeled trajectories should have been removed. A quick way to confirm this is to look at **<Edit>/<Delete Unlabeled Trajectories>**. This option should be disabled in the menu bar indicating that there are no more unlabeled trajectories to delete.

- 6) If you still have more than 41 trajectories, these will be the overlap trajectories that were created during joins. Overlap trajectories will have names like RSHO-4, or LFHD-1 (Figure 10). You can leave these in there if you wish. They'll be removed when you continue cleaning in Diva. Otherwise, for the most part they can just be selected and deleted. Note: if you have a particularly long overlap trajectory it might be worth taking a look at to make sure that it is not data that you would like to keep.

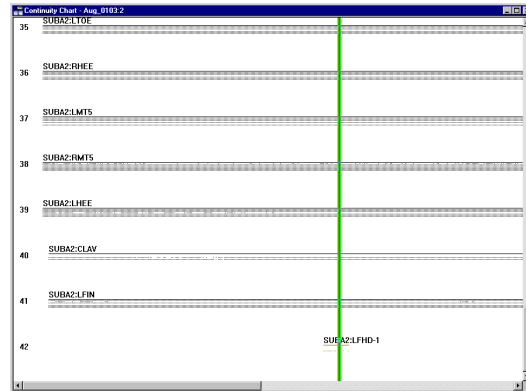


Figure 10: New Continuity Chart

- 7) You might still notice gaps in some of the marker trajectories where the marker disappears and reappears. This will be fixed in Diva. Workstation has two simple tools that can fill gaps but are not the best options to use. One is a linear filter **<Edit>/<Fill All Gaps>** which will fill all gaps in the entire trial based on the settings in **<Edit>/<Maximum Fill Gap>** window. You can also fill a selected gap linearly by using **<Workspace>/<Find Next Gap>** to locate a gap and **<Edit>/<Fill Selected Gaps>** to fill. The second option is to copy a pattern from one marker to another.
 - a) Open **<Window>/<New Continuity Chart>**.
 - b) Select **<Workspace>/<Find Next Gap>**. If you scroll in the chart, you will find that the marker that has a gap will be highlighted yellow and the gap has been marked with vertical lines with the playbar line in the center of the gap (see Figure)
 - c) Now select the marker that you want to copy from.
 - d) Select **<Edit>/<Copy Pattern>**
 - e) The pattern will have been copied but you won't see it in the chart until you right-click once to deselect the markers.

Section 6: Advanced Topics

Batch Processing

Several trials can be reconstructed and labeled in a batch using <Trial>/<Pipeline>.

- 1) Close any trial you might have opened. You should just have a directory window open.
- 2) Make the session folder that you want to work on the current session by double-clicking on the session folder name.
- 3) Select <Trial>/<Pipeline>. Check the boxes “**Reconstruct**”, “**Label**”, and “**Save Trial**”. This will reconstruct, autolabel and save the trial. Make sure “**Save Trial**” has been selected otherwise the system will reconstruct and label trial and then discard it to open the next trial (*Figure 11*).

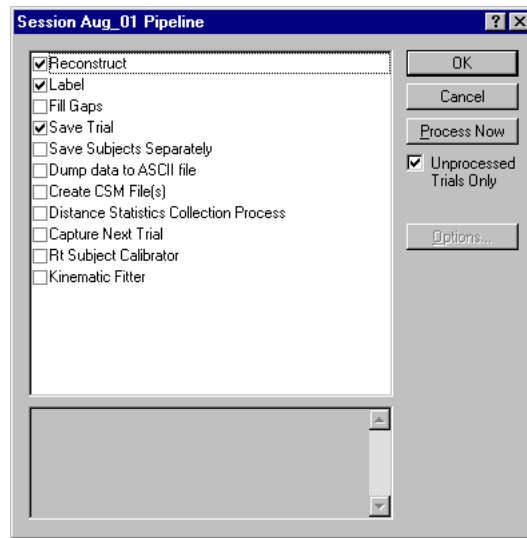


Figure 11: Pipeline Window – Multiple Trials

- 4) Make sure the box “**Unprocessed Trials Only**” has been selected. This will process those trials that do have reconstructed data already. **Caution:** If this is unselected, every trial in the session folder will be reconstructed and labeled and you will lose any work that you might already have done on other trials.
- 5) [**Process Now**]. Clicking [**OK**] will just save the settings.
- 6) A Processing Log window will pop up and will display the system’s progress.

If you want to reconstruct and label a single trial, open the trial you’re interested in and follow the same steps above. You will notice that you will no longer have the option “**Unprocessed Trials Only**” (*Figure 12*).

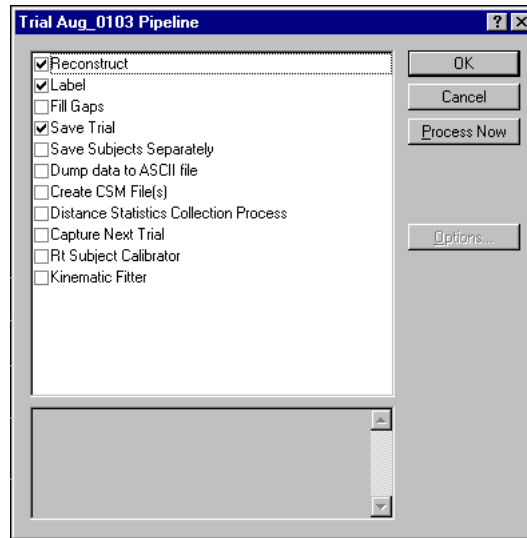


Figure 12: Pipeline Window – Single Trial

Creating Marker Sets

If the standard 41 markers were not used during the capture it will be necessary to create a marker set for that capture.

- 1) The easiest way to start is to first attach the marker set HumanRTKm.mkr from the C:/VICON/MODELS directory. If you remember, this makes a copy of that file in the current session's directory as the marker set.
- 2) Open the .mkr file in that directory. It will automatically open up in the BodyBuilder software.
- 3) When you look at this file, the first line will be “!mkr#2” Vicon just changed the format of this file. The first line tells the system which file format it's using. The file is divided into different Sets. The first set is the Autolabel set and is used by the system for Autolabeling. The second set is the Standard set and is defined for display purposes. There are other sets defined in the marker file, which are used in Bodybuilder. You will notice in the top right side panel of the Workstation window when you have a trial open the word Autolabel (*Figure 6*). The drop down list specifies the display set being used in your window. If you pick the second set Standard you will see a different set of green lines being drawn between the markers. You can create additional display sets if you like in the marker file.
- 4) We will be modifying the Autolabel set. You will need to add marker names and descriptions for any extra/different markers in your trial. You will then need to define/modify the rigid bodies and finally define connections between rigid bodies. Refer to pages 228-231 for more information on the format of the .mkr file and how to modify it. A detailed explanation can be found there.

Multiple Subjects

The process for multiple subjects/props is similar to that of single subjects.

- 1) A separate subject calibration is required for each subject/prop. When you create the autolabel calibration, give a different name for each subject/prop.
- 2) When you are auto-labeling the capture in which more than one subject/prop appears, make sure that under <Trial>/<Options> all the subjects/props are selected.


Facial Capture

In that case, determine where the subject will be sitting or standing. Mark the position on the floor with tape. Determine the camera setup. Place the flatcal on a tripod facing the cameras in approximately the same position as the face. Then do static calibration followed by dynamic calibration using the small wand in that small space.)

When editing trajectories in body builder, you need to worry about spikes at 5mm range in the graph for full body capture. For a facial capture, you should worry about spikes in the 1mm range.

Realtime for FiLMBOX and Maya 4.0

For FiLMBOX, realtime animation with motion capture data involves mapping the T-pose to a model in FiLMBOX, and creating a skeletal label for the motion data. Now the figure will move with the actor in the motion capture space. The documentation of this process is well covered in the FiLMBOX Manuals. Most of the processes that apply to realtime also apply to importing data from the disk, as well. But for now, real time display of the markers is accomplished by:

- 1) Select <**Realtime**>/<**Realtime parameters**>
 - a) Make sure that lag is set to 0, for Maya. Not needed for FiLMBOX.
 - b) For Maya, **Mode** should be set to Markers and Bodies.
 - c) For FiLMBOX, set **Mode** to Markers.
- 2) Select <**System**>/<**Pipeline**> from the menu bar, or the Pipeline icon 
 - a) Select the box to the left of **Distance Stat Coll Options**
 - i) Press [**Options**]
 - ii) Template file should be **HumanRt.kmt**
- 3) Select the Realtime button. (*icon goes here*)
 - a) Subject to capture, select subject and add
- 4) Make sure realtime is running on Clark. If not click on Tarsus shortcut on desktop. (*images here*)
- 5) Back to workstation. Select the menu item <**Realtime**>/<**Connect**>, or the icon, (**here**)

- 6) Make sure the subject is in the volume.
- 7) Select the menu item **<Realtime>/<Activate>**, or the icon (**here**) .
- 8) On Clark, realtime window should say that it sees 41 labels.

In Maya,

- 1) Select the menu **<Animation>/<Realtime>**.
- 2) Enter Clark's IP address, 128.146.18.13

In FiLMBOX:

- 1) On Thinice, start FiLMBOX by clicking on shortcut on desktop.
- 2) **<File>/<Motion Files>/<Import>/<C3D>**. Select T-pose file. To scroll, [Shift] + [Click and Drag] with LMB. Say yes to *Import as optical segments* and yes to *Create new one if necessary*. Use actor name prefixes. The marker data person will be facing along the negative z-axis.
- 3) You can see marker data realtime or map markers to model and see model animate in realtime. The creation of a character following motion capture data is sufficiently covered in the FiLMBOX Manual, volume 2.
- 4) Press **Elements**
 - a) Devices->Add (Vicon8RT Device)
 - b) Enter IP address for Clark 128.146.18.13
 - c) Optical model (C3D optical)
 - d) Click Online
 - e) Live on

If there are any problems with dropping limbs, change realtime parameters on workstation (frame lag).



Other FiLMBOX keys:

- 1) **Ctrl S** (to expand view to full screen, Ctrl S to return to previous view)
- 2) **Ctrl E** (normal view)
- 3) **Ctrl T** (top view)
- 4) **Ctrl W** (Schematic view)

Run a general capture (Section) with the grid of markers still laid out in the space. Then select any marker in the center of the space and press **<Ctrl><Shift><w>**. This will show which cameras see that marker. At this point, if the marker is in the center of the space every camera should be able to see it. You can run a similar test with other markers in the space to verify coverage of the space.

Importing data into Maya using Vicon .v file

This is accomplished by creating, from Workstation, a special, file format called a '.v' file. For this markers must be measured. Select a trial where the T-pose was captured.

Click on the green circle with the P  processed data, of the appropriate capture session. Select the pipeline icon  on the toolbar:

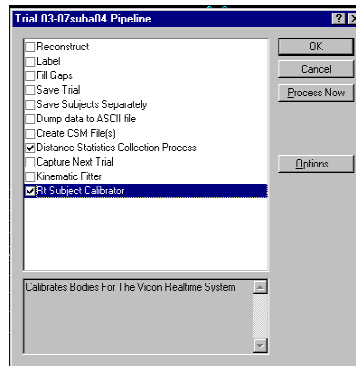


Fig. X Pipeline for V file.

- 1) Select the box next to “**Distance Statistics**”
- 2) Press [**Options**].
- 3) Make sure that the file **HumanRTKm.kmt**, found in **C:\Vicon\Models** folder, is in the Model types window.
- 4) Select “**Rt Subject Calibration**”; this appends rotational values.
- 5) Press [**Options**].
- 6) Make sure that HumanRT.kmt is selected for the Template file.
- 7) Press [**Process Now**], *hitting [Enter] does not process the data.*
- 8) If problems occur, select [**Cancel**]. Then go back to options under “**Rt Subject Calibration**” and select “**Reprocess Skeleton**”, and [**Process now**], again.
- 9) Get to the **Pipeline** icon. Select, check mark, “**Kinematic Filter**”, and [**Process now**]. This will create a ‘v’ file, name is the same as the name of the trial, with a “.v” extension, in the same folder.
- 10) At this point creating a ‘v’ file for any other trial for the same subject involves just selecting the green P for that trial and repeating step 9.

In Maya, select <**File**>/<**Import**> and select the ‘v’ file. Mapping characters in Maya to the motion data is another can of worms.