

# **Quintic Software**

## **Tutorial 8b**

Automatic Digitisation

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## 1. Automatic Tracking

Open the video “**Cycling\_100fps.avi**” from the ‘**Cycling**’ folder.

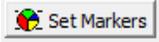
Before starting automatic digitisation the video must be calibrated and a suitable frame template must be available. Please refer to Tutorial 8a for instructions.

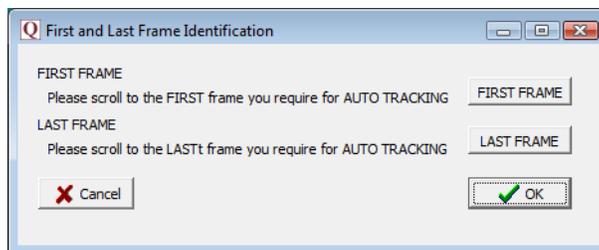
In the Main window click on ‘**Digitisation Menu**’ and then ‘**Automatic Digitisation of a New Trace...**’

A window may pop-up asking if you want to ‘**overwrite the existing trace**’. Click ‘**Yes**’.

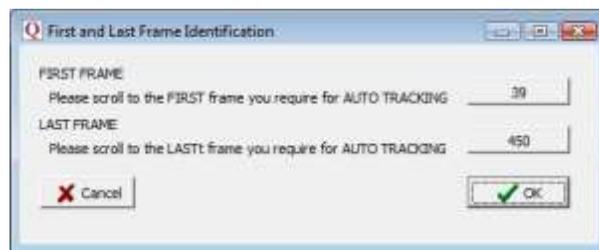
A pop up window will now ask you to select a suitable reference model click ‘**OK**’ and navigate to the ‘**Cycling**’ folder and open ‘**AutoTracking\_Cycling**’ 4 point template.

A new window will now open containing the same video that is in your main window.

Click on the  button. You will now be prompted to select the first frame from which you wish to start automatically tracking.

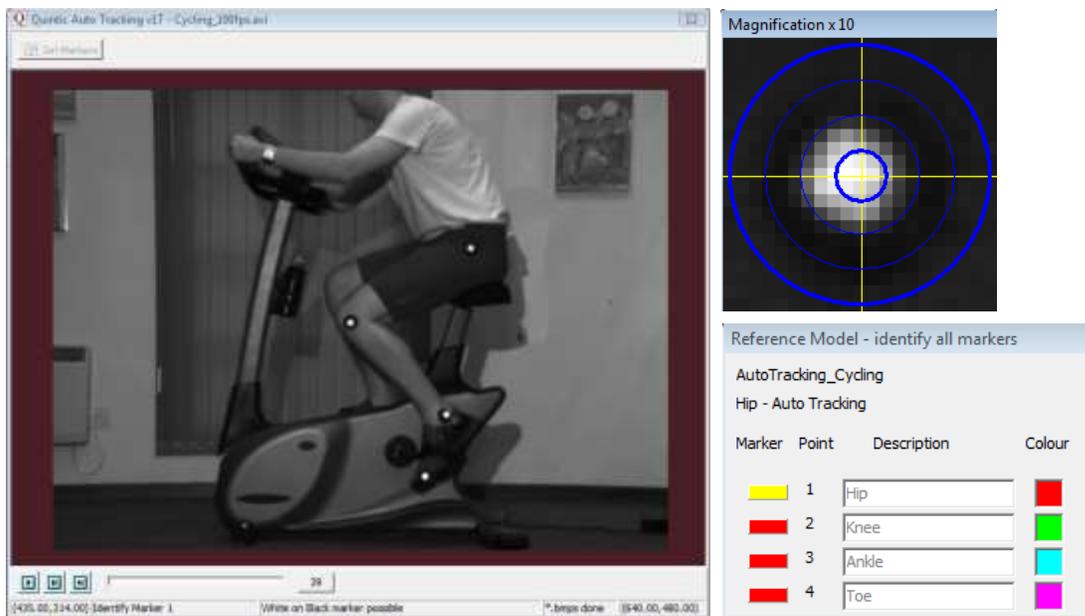


Scroll to the frame you wish to start the tracking from and click on ‘**FIRST FRAME**’, now scroll to the last frame that you wish to digitise and click on ‘**LAST FRAME**’.



Once you have set the range of frames you wish to automatically digitise, click on the ‘**OK**’ button to begin identifying the body markers.





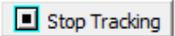
As the cursor moves across the screen, the magnification window shows a larger version of the area under the cursor. The magnification window allows the user to pinpoint the exact marker locations. This must be done in the correct order. The reference template illustrates the order of marker identification. If the symbol next to the point description is yellow this indicates the marker needs to be identified.

To identify a marker position move the cursor over the relevant marker and click the screen, the program will automatically calculate the centre of mass of that marker to improve the accuracy. Once a marker has been successfully identified the symbol will become green, the next marker can then be identified.

Once all the markers have been identified, click **'OK'** on the pop up window to start tracking the identified markers.



Click on the  **Start Tracking** button to begin the automatic digitisation process, the video will begin to play, and the identified markers will be tracked automatically.

The digitisation process can be sped up or slowed down by using the scroll bar at the top of the window, digitisation can also be paused or stopped at any point by using the  **Pause** and  **Stop Tracking** buttons located at the top of the digitisation window.



The digitisation process will now continue until the video has played through, the stop button is pressed or one of the markers is lost.

When the last video frame has been digitised or if the user clicks stop tracking, a pop up window will appear to inform the user that they can now review, edit, recalibrate and filter the data. Click on '**OK**' to save the trace and progress to the review window.

#### a. Lost Marker

During automatic tracking, markers can become obstructed by moving limbs, lost due to rotation, or the marker moving out of the field of view. If a marker cannot be automatically digitised at any particular frame the digitisation process pauses for the user to select '**Manual Tracking**' or '**Interpolation**' of the selected marker – see below.

#### b. Manual Tracking

The picture below illustrates a marker being obstructed by a moving limb, causing the marker to be lost and the digitisation to pause. To be able to continue automatically digitising, manual digitisation may be performed for this frame.



To manually track a marker(s), firstly identify which marker has been lost, this is indicated by the yellow symbol next to the marker point description in the reference model window. Also notice that the manual column has now been selected for the knee marker, e.g. the picture above illustrates that the knee marker has been lost.

To manually track the 'lost' marker, left click on the area of the screen that the knee marker should be (you may have to estimate if the marker is completely obstructed).

This will load a magnification window so that you can pinpoint the marker position more accurately. Left click on the magnification screen to track the point.

The lost marker has now been successfully tracked and digitisation can now continue.

If the marker remains 'lost' for a couple of frames, continue to left click in the area of the screen that you perceive the marker to be in, using the magnification window to improve the accuracy. Once the marker reappears, right click on it to set the tracking process to automatic. The magnification screen will appear. Now left click on the centre of the marker. The digitisation process will now continue automatically, until another marker is lost or the end of the video is reached.

### c. Marker Interpolation

This function can also be used when a marker becomes 'lost' (can save time when the marker is 'lost' for several frames and the movement is regular).

Interpolation instructs the software to predict where the maker will move to and fit a line of best fit through the interpolated frames.

The picture below illustrates the same 'lost marker' scenario as before.



Once a marker has been lost, the digitisation process will pause as before and the manual column will be selected, however Quintic recommends pausing the video before the marker is lost for increased accuracy.

To use interpolation select the interpolation option for the lost marker in the reference model window, once this is selected the video will continue. The software will now continue to track all of the markers except the interpolated point. Once the interpolated marker can be seen again click on the  button and set the interpolated point back to manual within the reference model window.

When interpolation is finished the software needs a reference point for calculation. After **'Manual'** has been selected, click on the  button and manually track at least the first following frame. More frame reference points will result in better interpolation - Quintic suggest at least 3 following frames are manually digitised. You can now right click to identify the marker on the next frame and the software will return to automatic tracking.

Because of the need for a final reference point for calculation, Interpolation Mode must be finished before the end of the video or before the marker moves off the screen. Quintic suggest at least 3 frames are manually digitised after interpolation finishes.

After completion of the digitisation trace, the trace can be reviewed, as well as edited to correct any anomalies within the trace. Butterworth filters can also be applied to the raw data to smooth out any anomalies.

#### d. Digitisation Trace Review

This is the main window after completion of the digitisation, allowing the user to review the trace as well as select the edit, re-calibrate and filter options.



To review the trace use the play, pause and frame-by-frame buttons located at the bottom of the window. There are also a number of functions available to vary the way in which the trace is displayed on the video clip:

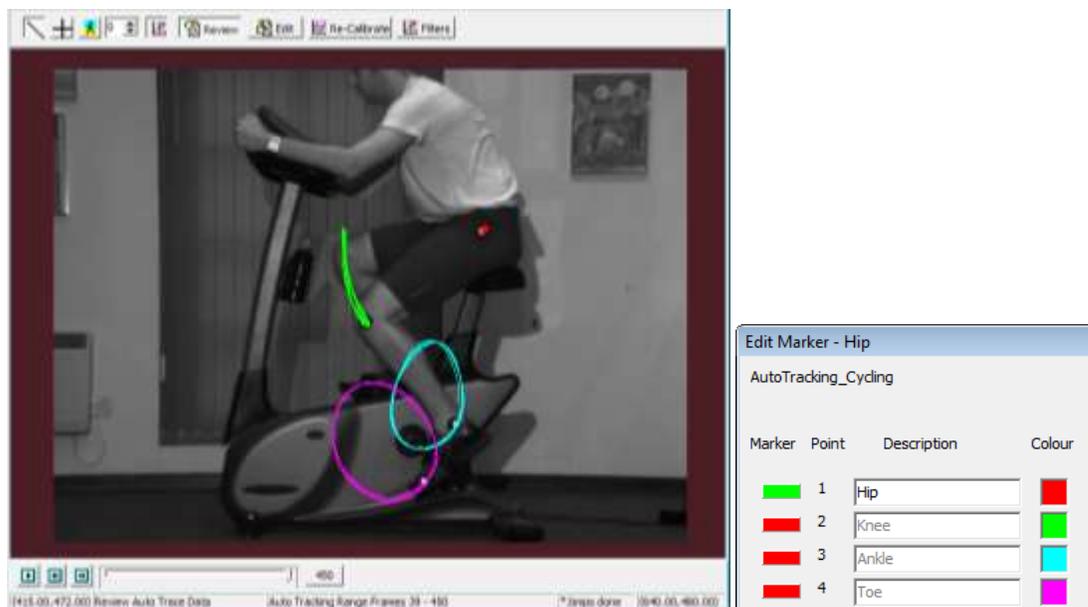
-  - Shows the traces from individual frames. (This function is not available in Quintic Coaching).
-  - Shows the crosses created during the digitisation for every frame.
-  - Snail Trail: Allows the user to see the last X number of frames (5 will show the current frame plus the trace for the previous 5 frames).
-  - View Individual Frames: The trace is displayed frame-by-frame.
-  - Show/ Hide Trace: When this button is **not** selected, the entire trace will be displayed when you play the clip. When this button **is** selected, the trace will develop as the clip is played.

## 2. Editing a Trace

Individual marker points can be edited after the digitisation process has been completed.

The easiest way to decide if a trace does need editing is by using the review function.

To edit a trace click on the  Edit button, this will open a new side window.



Select the trace you wish to edit by clicking on the colour marker, next to the marker description. A green symbol will indicate that this is the trace that is going to be edited.

**N.B.** You can only edit one trace at a time.

After selecting the trace you wish to edit, scroll the video to the frame where the error occurs, and left click on the correct marker position.

After clicking on the correct marker position a magnification will open allowing you to improve the accuracy of your selection.



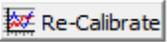
After selecting the new co-ordinates for the marker, another pop up will ask you to confirm your selection. Click on 'Yes' to edit another trace/point. If you are unhappy with your new marker placement click 'No' and reselect the marker position.



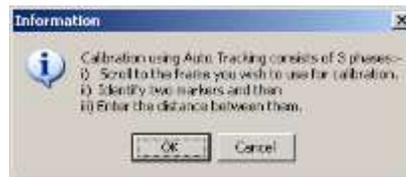
To exit from the editing mode select one of the other options from the top menu bar or close the window.

### a. Recalibration

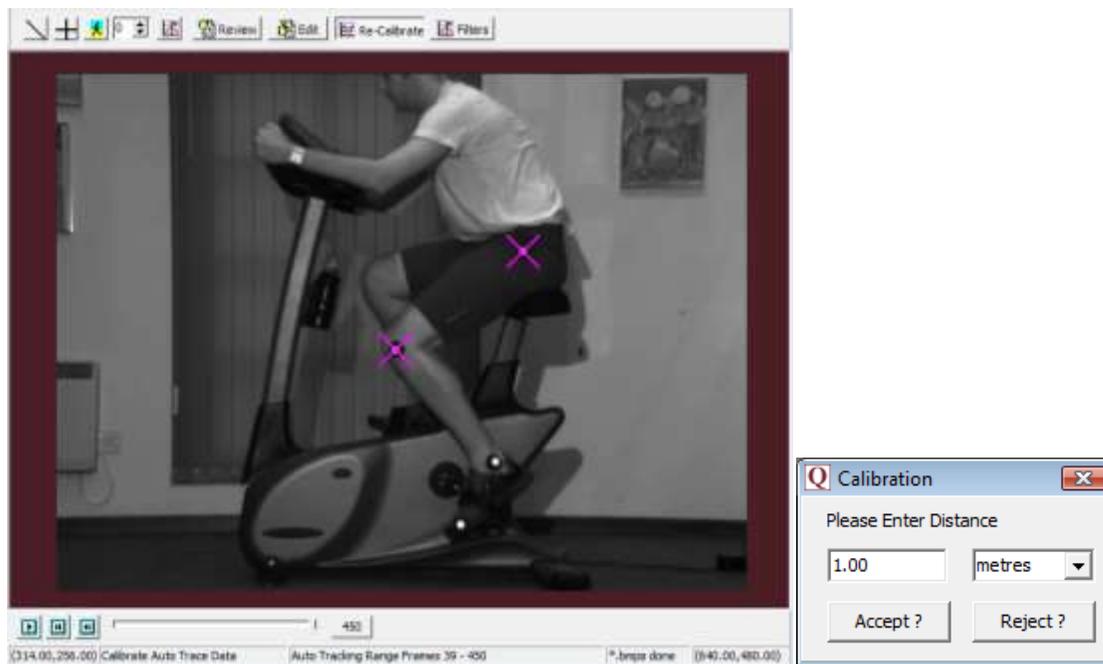
Although the calibration process was executed at the beginning of the digitisation process, this can be overwritten by calibrating the distance between any two markers.

Click on the  button, a window will pop up stating that a calibration file already exists for this video if you wish to re-calibrate click '**Yes**'.

Another text window will now load, detailing the recalibration procedure, read through this and click '**OK**'.



Scroll to the frame at which you wish to recalibrate the video (making sure the markers you want to use for the calibration are in the field of view).



Click on the 2 markers that you want to use for the new calibration. The centre of each marker will be automatically selected. As soon as the second marker has been identified, a calibration window will load, enter the new calibration distance in either metres or inches and click '**Accept**'.

The new calibration factor has now been saved and applied to the digitisation.

### 3. Butterworth Filters

#### a. Filters (Smoothing the Raw Data)

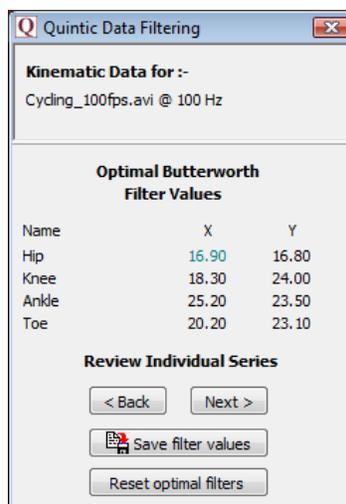
It is important to smooth data that has been produced via automatic or manual digitisation to remove any errors that may have occurred during the digitisation process, e.g. marker /skin / clothing movement errors.

Click on the  button to open the filters screen, a pop up window will now open prompting you to filter your data.

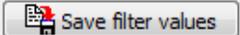


Click on the 'Yes' button to begin the data filtering procedure.

The 'Quintic Filtering' window will now load, illustrating the optimal Butterworth Filter values that have been placed on the data to smooth any data anomalies that may have occurred during the digitisation process.



Before saving, it is good practice to review the filter settings to confirm optimal filters have been placed on the data. Click on the  button to consider the Butterworth Filter values for both the X and Y co-ordinates of each marker that has been tracked, which will be shown in an additional window.

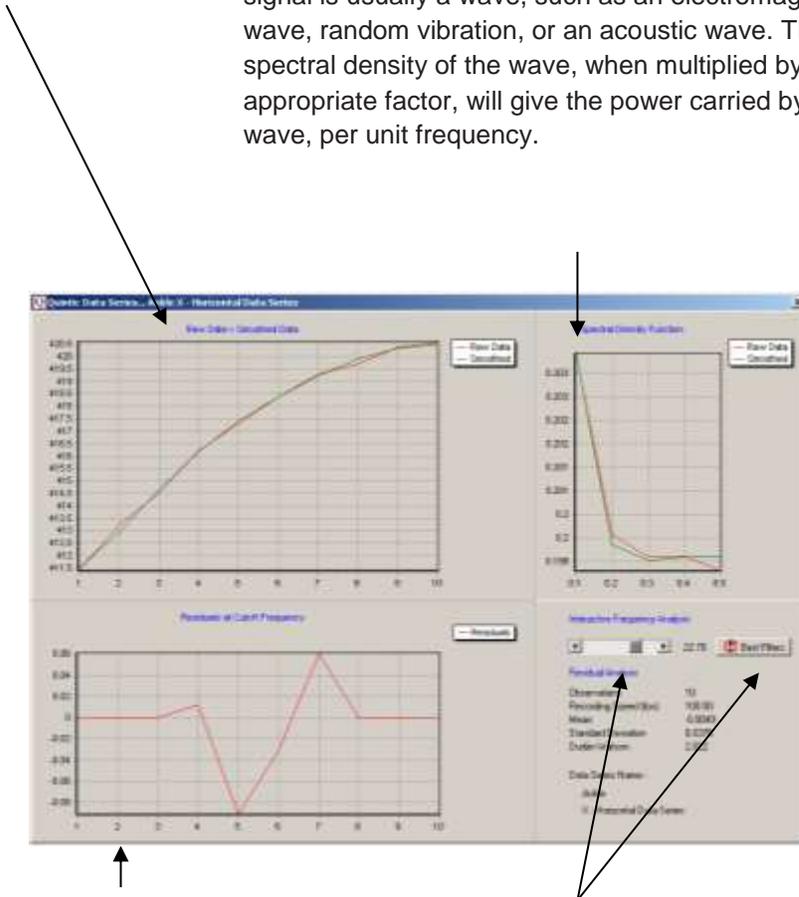
These filter values can now be saved, by clicking on the  button.

**Raw Data Vs Smoothed Data**

This graph illustrates values for both the raw and smoothed data.

**Spectral Density Function**

Describes how the energy (or variance) of a signal or a time series is distributed with frequency. In physics, the signal is usually a wave, such as an electromagnetic wave, random vibration, or an acoustic wave. The spectral density of the wave, when multiplied by an appropriate factor, will give the power carried by the wave, per unit frequency.



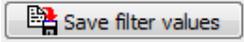
**Residuals at Cut off Frequency**

This illustrates the difference between the raw and smooth data. Good values should oscillate around 0. If predominantly positive or negative values are produced an incorrect filter value has been used.

**Interactive Frequency Analysis.**

This function allows the user to control the level of filtering that is placed upon the raw data, by using the scroll bar. To reset the filters back to their optimum value click on the 'Best Filters' button.

To smooth the data of a previously digitised trace load the digitised video in the main window and click on the 'Digitisation' tab. Open the 'Digitisation Menu' and select the 'Data Smoothing of current trace option' this will open the Quintic filtering windows shown above. You can check the optimal filters values that have been used on the data and alter them if you wish.

These filter values can now be saved, by clicking on the  button.