



Articulate Assistant Advanced™
EMA Module User Guide

Version 2.11

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Importing EMA data

Importing can be done in four ways

1. By importing EMA pos files and associated wav files together plus PRAAT textgrid files if present.
2. By importing EMA pos files and associating manually each pos file with a wav file already present in the current project.
3. Importing EMA pos files to match with wav data originally recorded at the same time with the multichannel system (This differs from 2 above because the recordings in the project retain information about which pos files match them and so the matching is done automatically)
4. Importing AG200 *.0?? , *.1?? , *.2?? , *.M?? data files and PRAAT textgrid files if available.

To import EMA and audio data that you have recorded using the standard Carstens equipment:

STAGE 1 Importing EMA and associated wav data

1. Load or create a project that you want the EMA and wav data to be imported into.
2. Select the 'File|Import EMA...' menu option to open the EMA import dialogue.
3. Select the "Import into new recordings" tab.

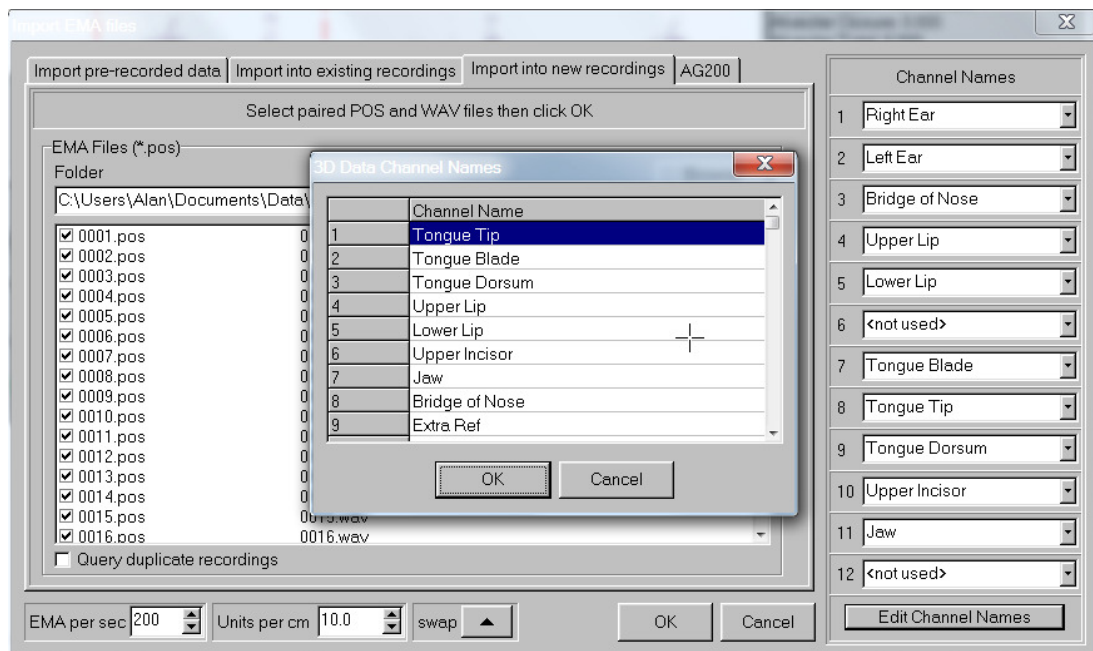


Figure 1 EMA Import Dialogue with channel name editor open and the names "Right Jaw" and "Left Jaw" added

4. Select the folder containing the EMA pos files and associated wav files. Note: The wav files must be in the same folder as the pos files and have filenames that match.

5. Specify the channels name assignments. (If appropriate names don't appear in the dropdown list then add them to the list using the Edit Channel Names button).
6. Check the boxes corresponding to the recordings you wish to import with the specified channel assignments (Figure 2). Note that this allows the assignment to be changed part way through a session.
7. Click OK to import the data into the current

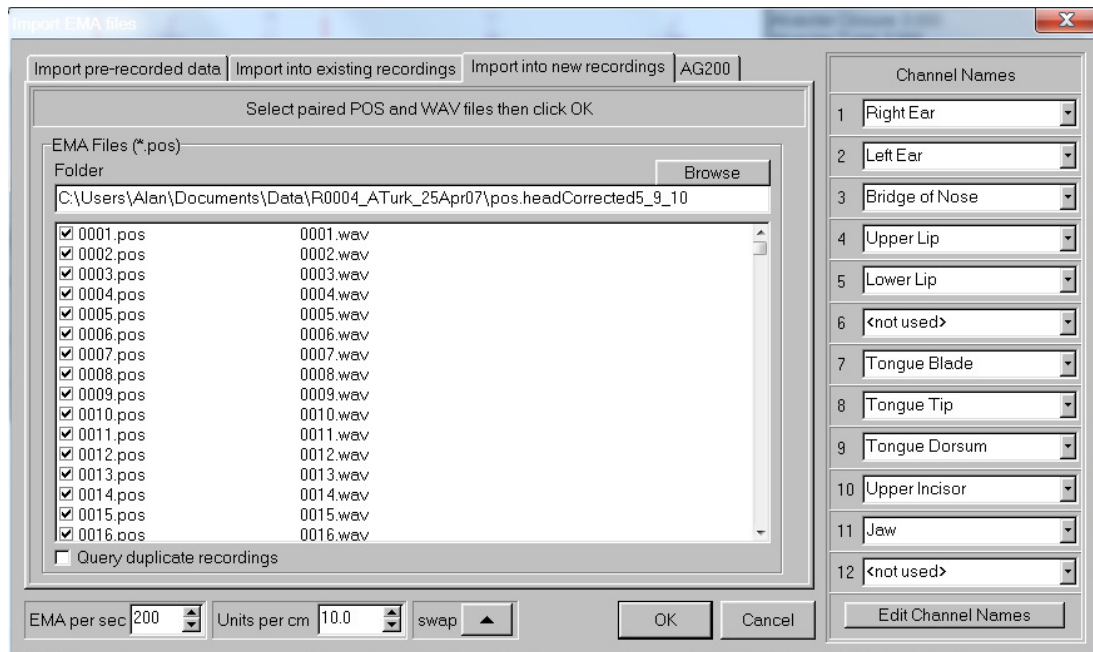
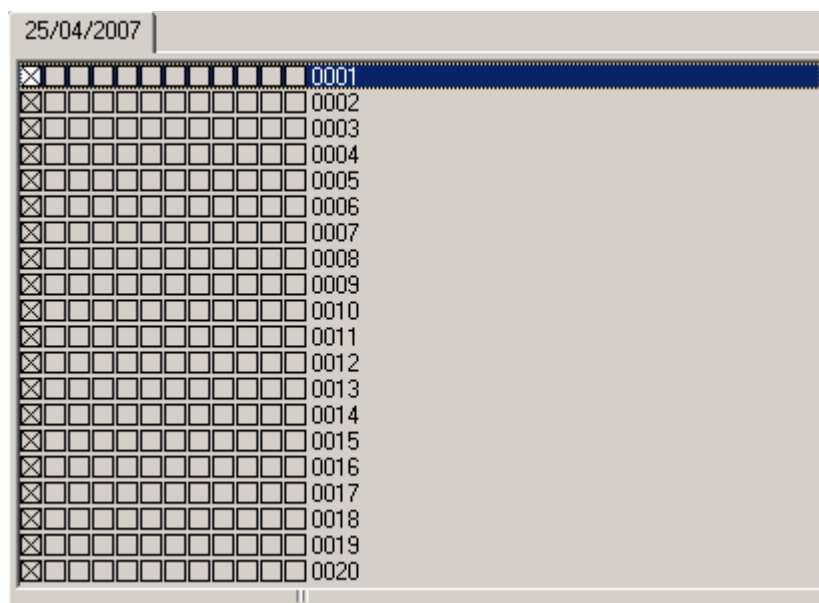


Figure 2 EMA Import Dialogue with recordings selected and Channel names assigned.

8. Data should then appear in the Prompt list window.



STAGE 2 Converting raw EMA data into analysis values

The second stage involves converting the imported data into analysis values. To do this:

9. Click on the Menu option 'Options | Analysis Values...'
10. Click on the **3D Data** button and the "Add EMA Analysis" box will pop up (Figure 3).
11. Select a channel name from the list that corresponds to a channel you have just imported. Note that if analysis values with the same name have been set up for previous recordings, they do not need to be set up again. All three x,y and z displacement values are automatically created when the OK button is clicked.

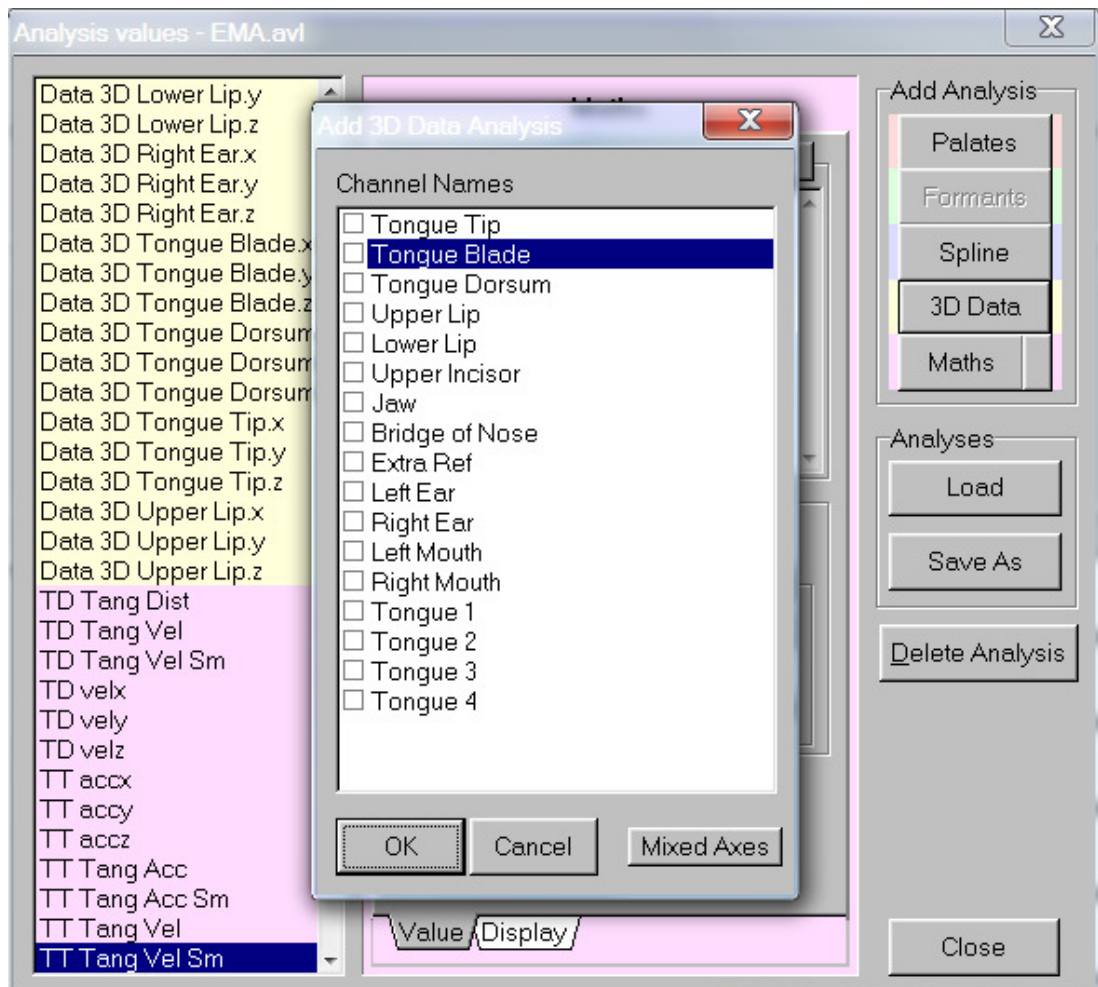


Figure 3 Analysis Values Dialogue with Add 3D Data (EMA/VICON) Analysis option selected

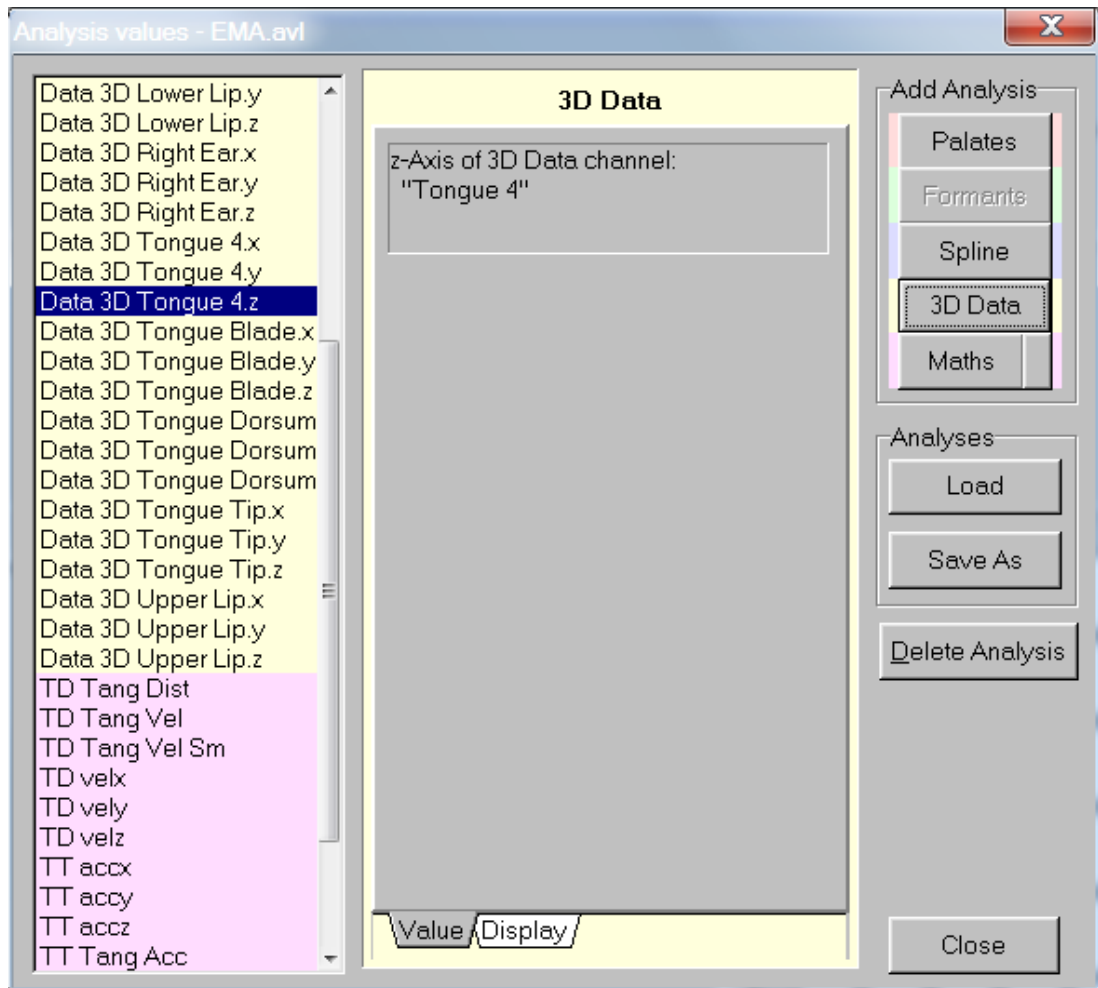


Figure 4 Analysis values dialogue with 3D Data (EMA/VICON) xyz displacement values loaded for each channel.

The Display tab provides options to hide analysis values in the Analysis Values Text window, in the Edit charts list and in the list of values to plot in the 3D plot window. This is useful to de-clutter these lists. For instance, if only the y-values are of interest then the x and z values can be hidden, reducing the length of the list that needs to be scrolled through to find the value of interest.

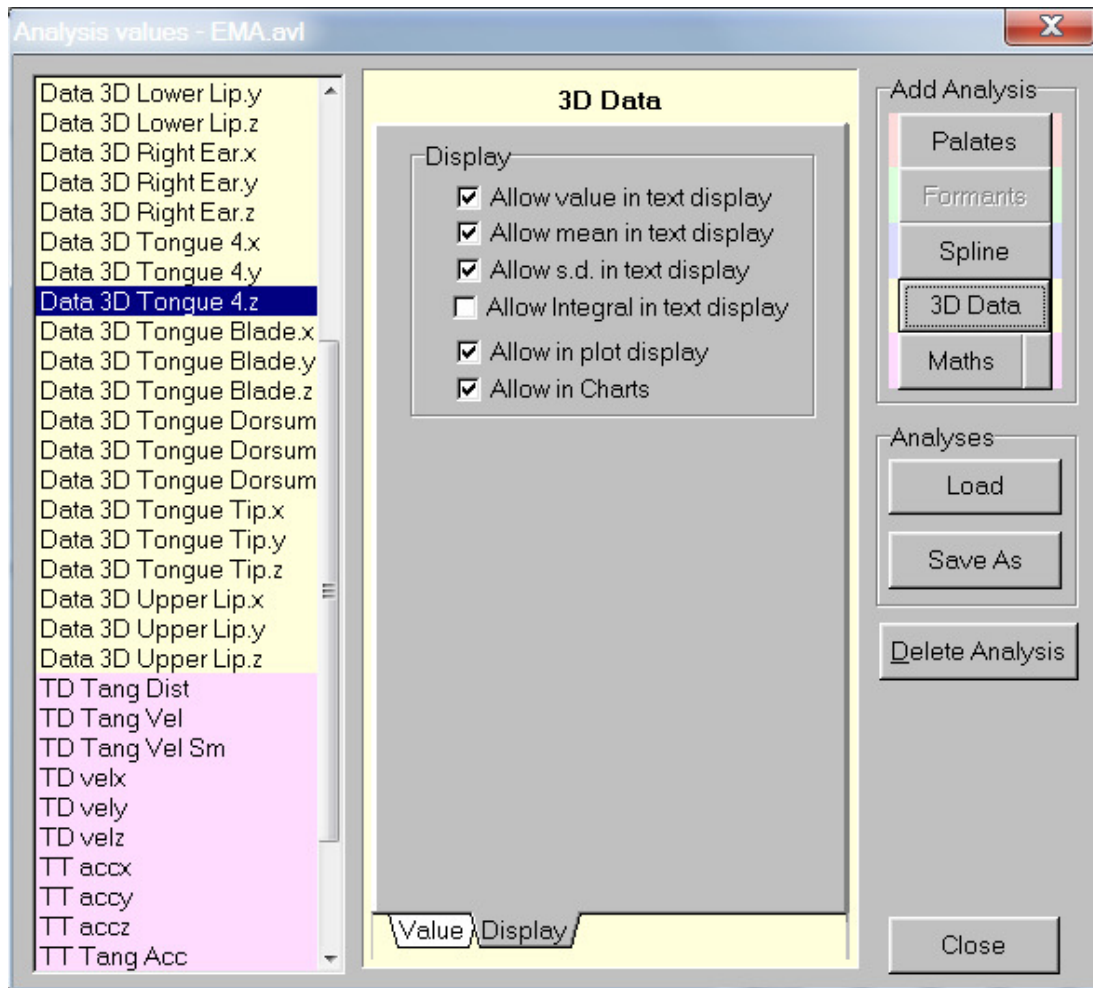


Figure 5 Analysis values dialogue showing the Display tab which provides options to hide the value from being displayed. Useful for decluttering lists.

STAGE 3 Plotting EMA analysis values

Now that the raw data has been turned into analysis values it is possible to plot them and to further process the displacement values to smooth or differentiate. Notice that all the EMA displacement values are automatically selected for display in the current analysis chart. See the section on Editing analysis charts in the AAA User Manual for help in rearranging the display. As well as displaying EMA values in a chart with magnitude vs. time, it is possible to plot the values in 3 spatial dimensions in the 'Plot window'. This can be done in the following way:

1. Right click on the plot window and select the "Edit..." option from the popup menu to open the Edit Plot dialogue.
2. Select the 'EMA axes ' tab and click **Add Graph** to add one channel.
Note: Only add one channel at the moment until the settings for the first channel have been chosen then subsequent channels will pick up the same settings.
3. Set the min an max values for each axis (see Figure 8)
4. Select the 'Plotting' tab and set the 'Fade with age' option to (see Figure 9)

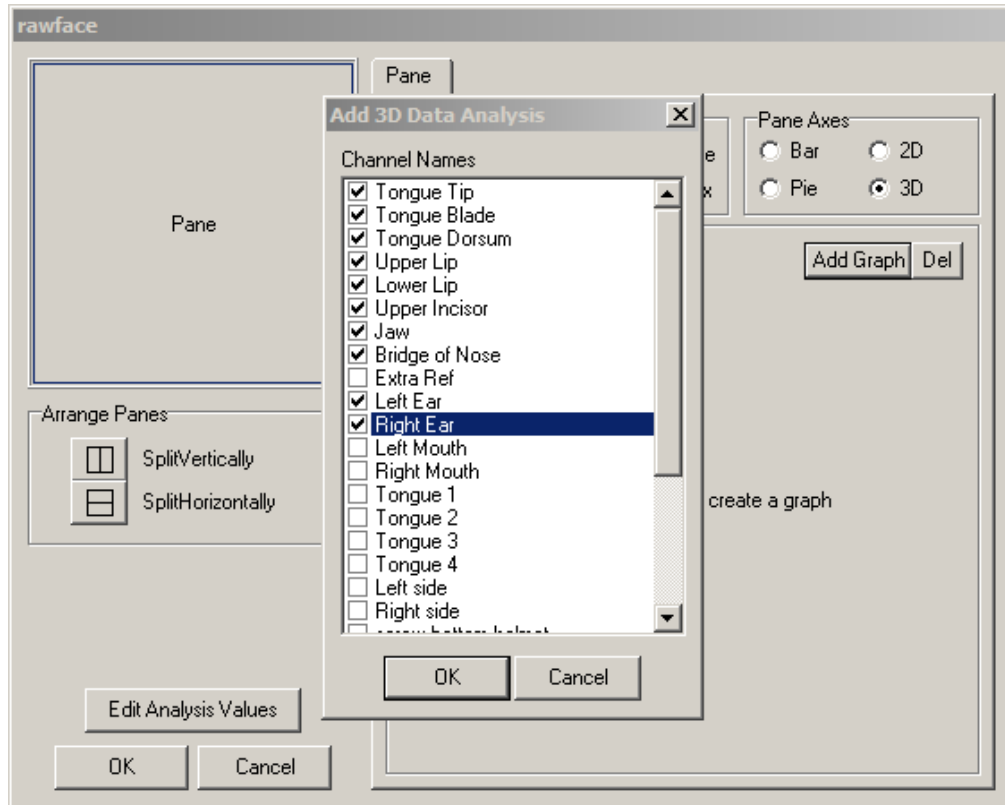


Figure 6 Edit Plot Dialogue with 3D option selected. Add graph brings up Channel selection dialogue to select the desired 3D channels

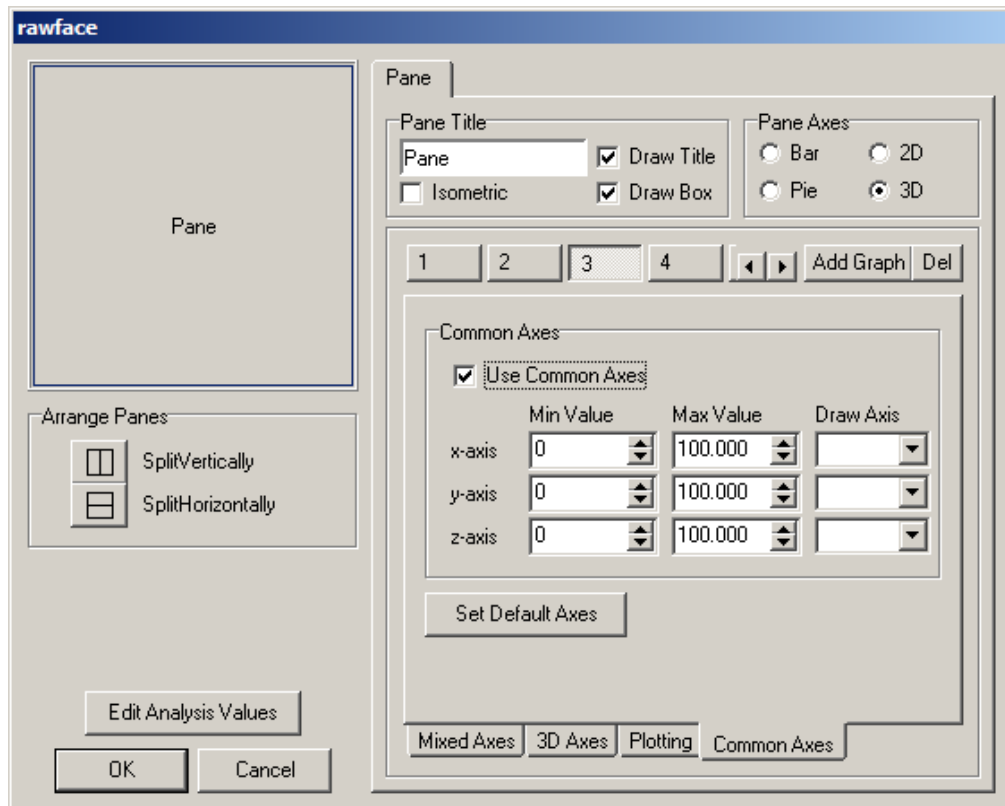


Figure 7 Edit Plot dialogue with "Common axes" tab selected and "Use common axis selected". Use this to set each axis to be the same for every channel.

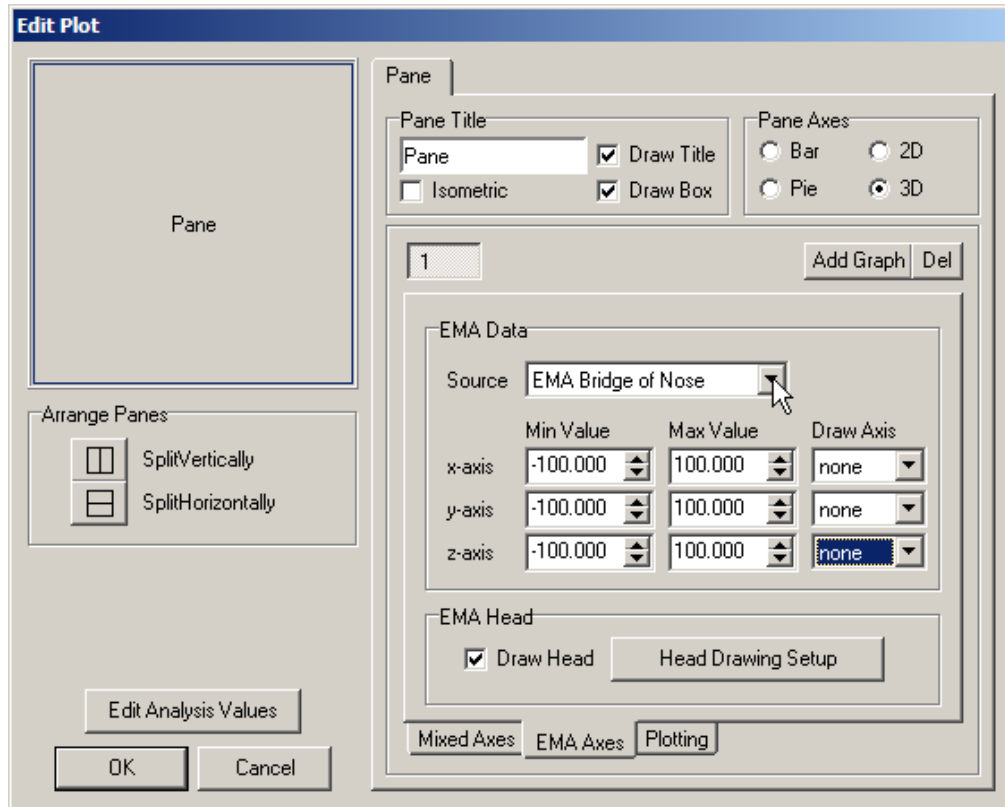


Figure 8 Edit Plot Dialogue showing 3D plot selected in a single pane with the 'EMA axes' tab selected to allow each EMA channel to be added easily

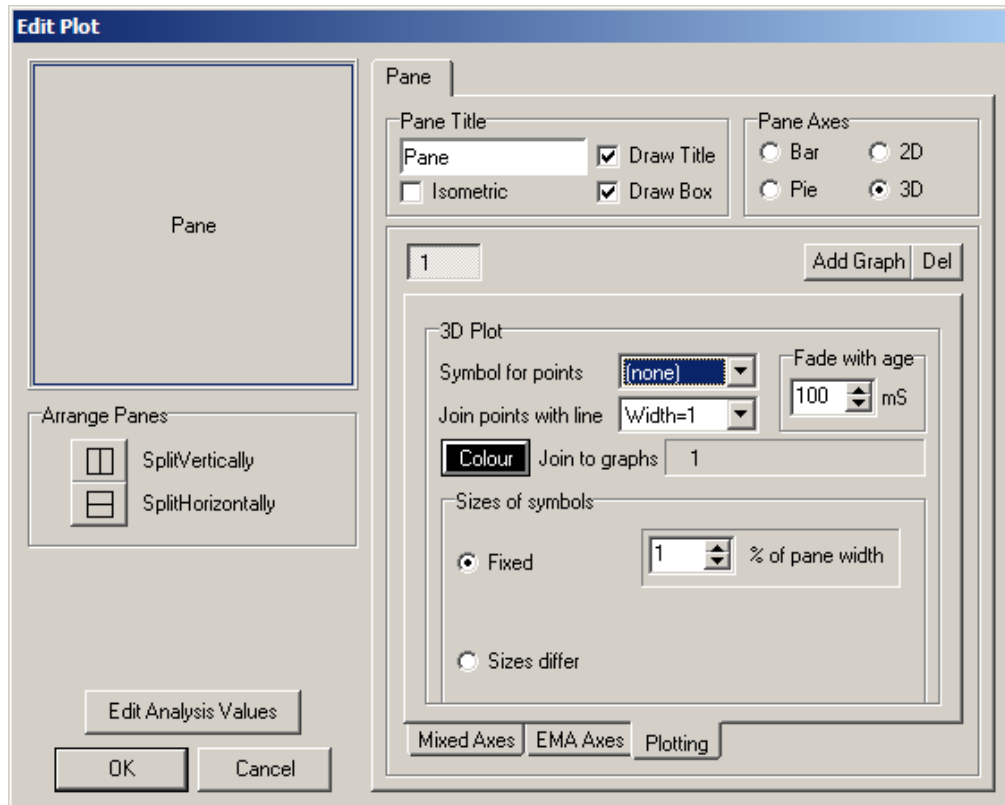



Figure 9 Edit Plot Dialogue showing plotting tab with 100ms 'fade with age' selected

5. Select the EMA axes tab again and add the remaining channels that you wish to plot.
6. Set up the Head Drawing parameters using the  button.

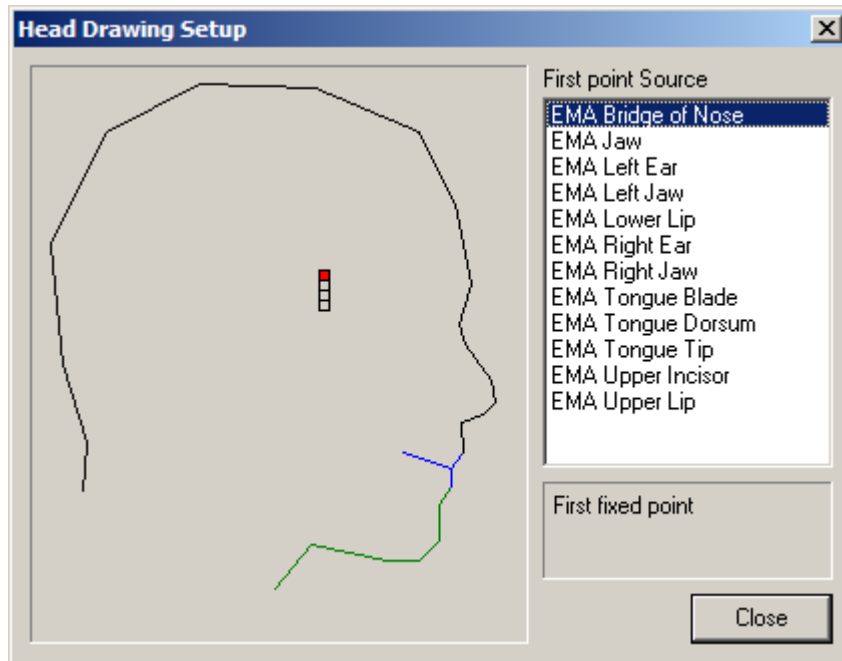


Figure 10 Head Drawing Setup Dialogue

- a. Click and drag the highlighted marker labelled 'First fixed point' to the Bridge of the nose on the outline of the head and click on the analysis value named Bridge of nose. (see Figure 10).
- b. Click and drag the highlighted marker labelled 'Second fixed point' to the upper incisor position on the outline of the head (or wherever the second reference point is) and select the appropriate analysis value from the list.
- c. Click and drag the highlighted marker labelled 'Point defines plane of head (can be mean of two points)', move the marker and select left ear AND right ear in the list
- d. Select the final marker and move to where the jaw sensor is and select jaw from list.

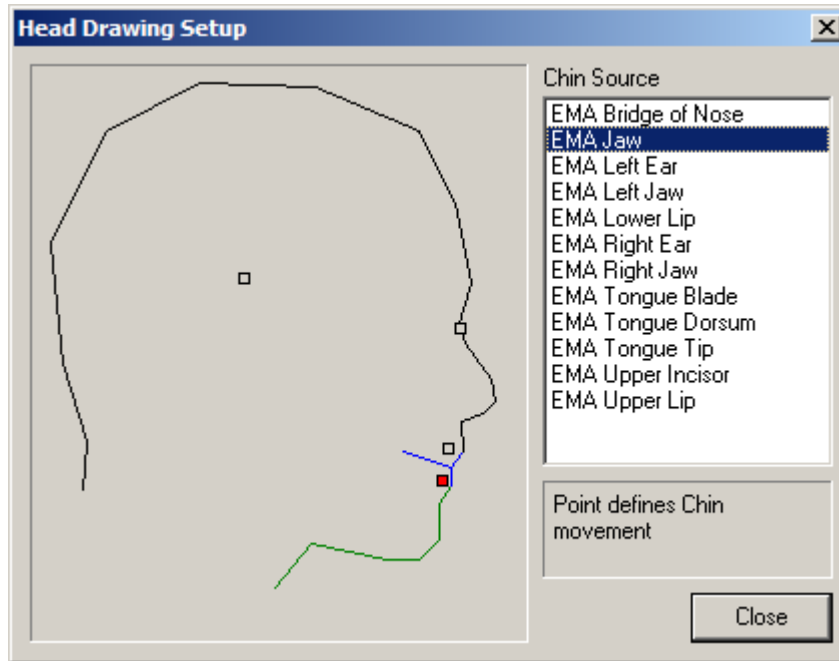


Figure 11 Head drawing setup with markers in typical locations

7. Select the 'Plotting tab' and choose which channels to link together with a coloured line. For example to link three tongue sensors, select the graph with the middle tongue coil (in Figure 12 Graph 10 is the tongue blade sensor). Then click on the number on the array labelled 'Join to graphs' that corresponds to the tongue tip. A colour dialogue will pop up. Select the colour you wish for the line joining the Tongue blade to the tongue tip and click OK. Do the same again for the graph number corresponding to the tongue dorsum.

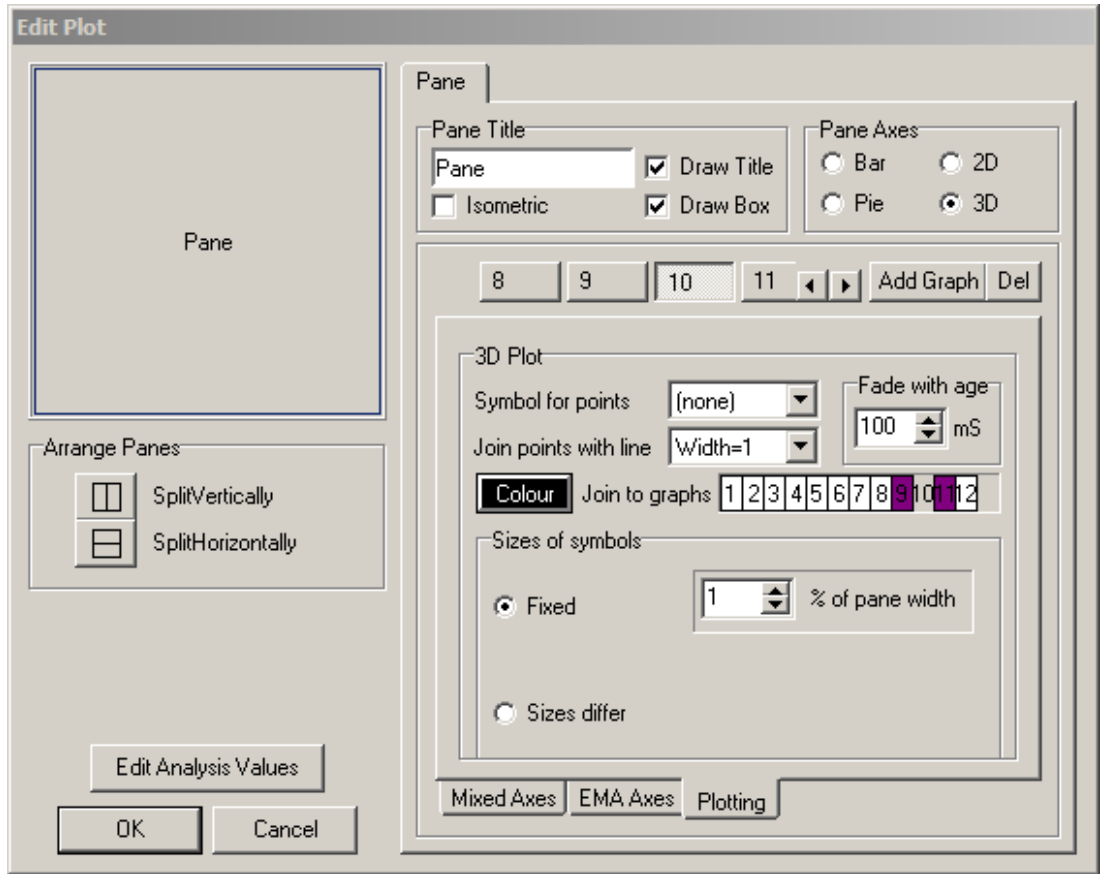


Figure 12 Selecting sensors to be linked together

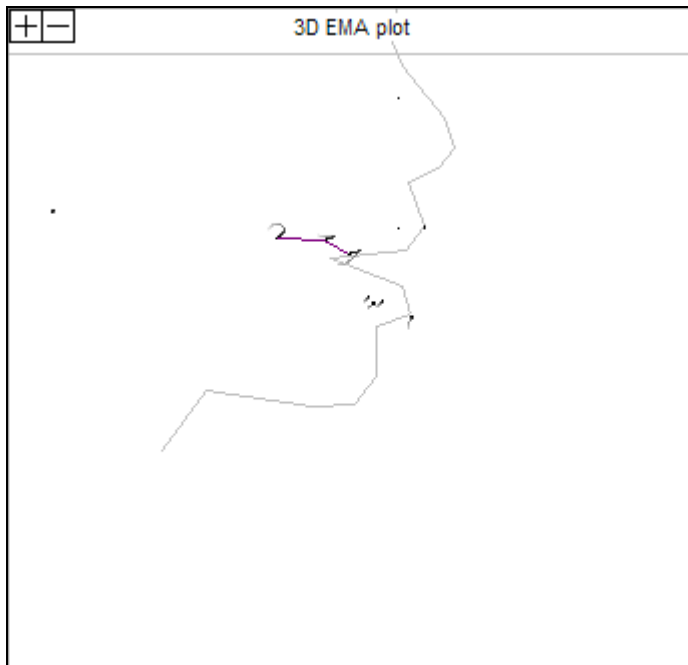


Figure 13 Plot Window. Resulting 3D plot with tongue coils connected and silhouette of head visible

Recording VICON Data

Importing VICON Data

EMA Analysis

The 3D EMA Display

The previous section showed how to prepare EMA data for display in a 3D

EMA Analysis Values

Smoothing

Smoothing of EMA displacement data is important as it allows peak detecting algorithms to work and is crucial in removing the effect of noise in the measurement when calculating velocity and acceleration traces. Low-pass digital FIR filters can be used to remove high frequency components but if the low-pass cutoff frequency is set too low then some of the components of the underlying displacement trace will be lost. In AAA we use moving average smoothing filters and in particular the Savitzky-Golay smoothing filter. The Savitzky Golay filter is a generalised moving average where the filter coefficients are derived by performing an unweighted linear least squares fit using a polynomial of the specified degree (2 or 4). As a rough guideline, best results are obtained when the full width of the degree 4 Savitzky-Golay filter is between 1 and 2 times the Full Width at Half Maximum of the desired features in the data.

These values can all be displayed in the 'Analysis Values' chart display (Figure 14).

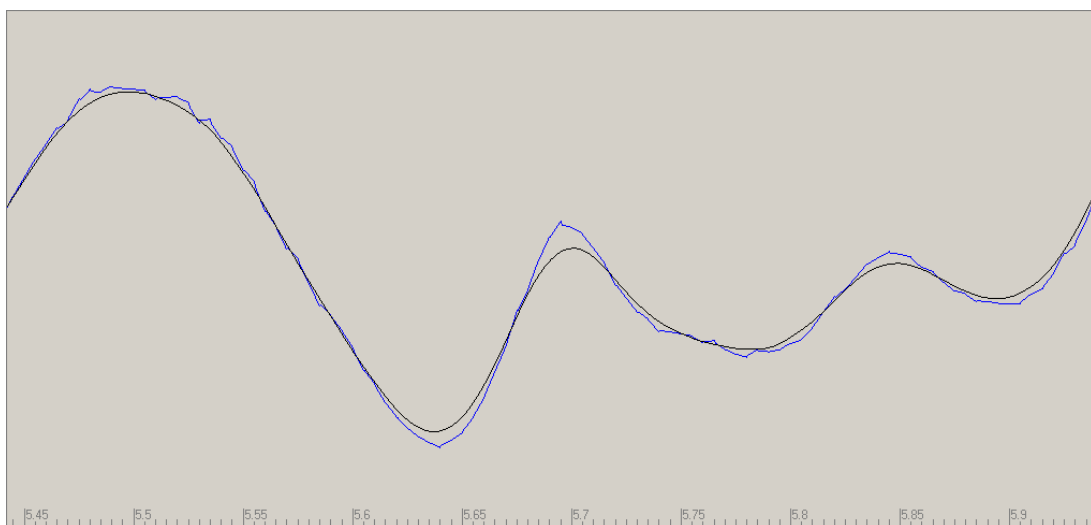


Figure 14 Raw Tangential velocity (blue) ; Smoothed Tangential Velocity (black) using rectangular window of 20ms

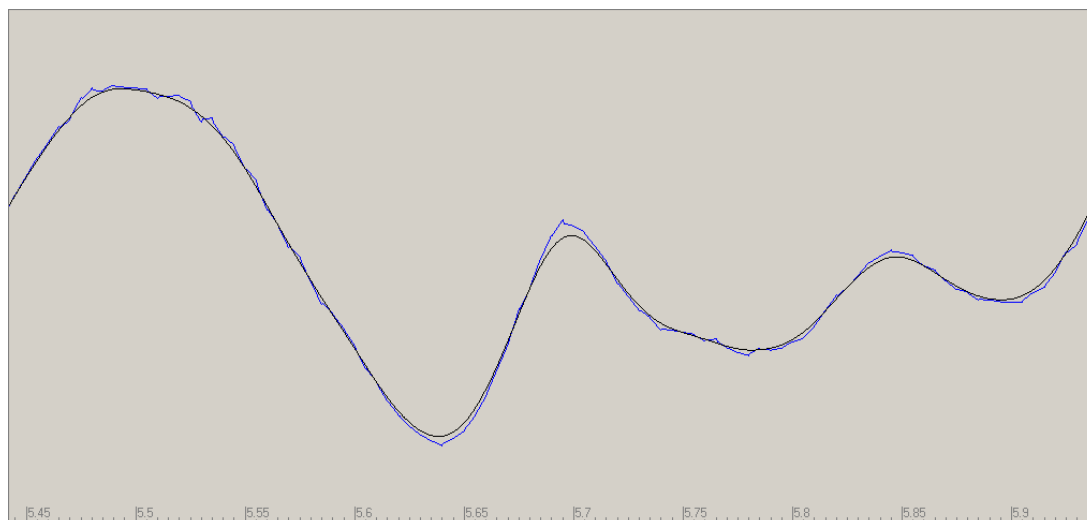


Figure 15 Raw Tangential velocity (blue) ; Smoothed Tangential Velocity (black) using triangular window of 20ms

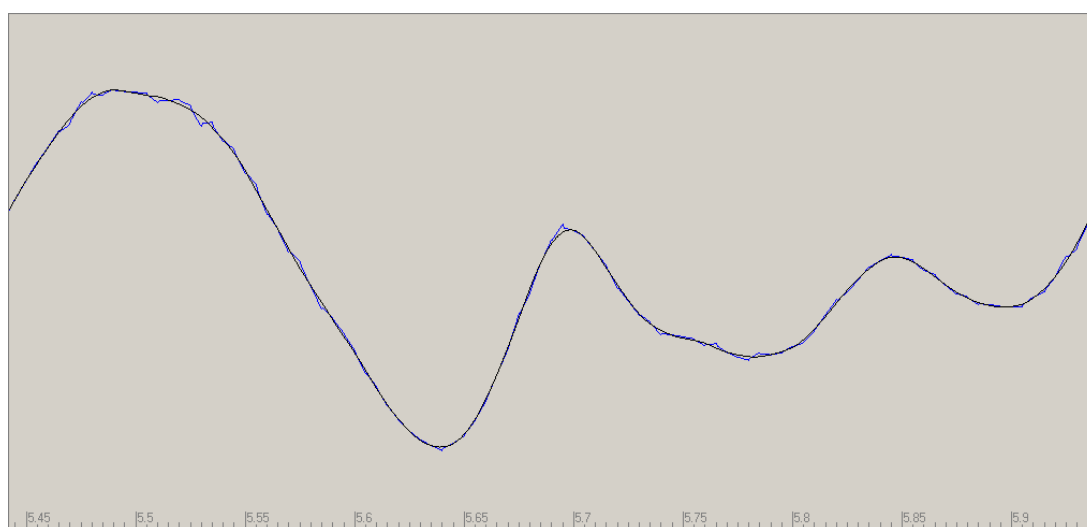


Figure 16 Raw Tangential velocity (blue) ; Smoothed Tangential Velocity (black) using 2nd order Savitzky-Golay window of 20ms

When smoothing EMA displacement data, a good default setting is to calculate the smoothed data every 1ms with a 20ms window using the 2nd order Savitsky Golay (savgol) weighting function. This results in smooth data that fits the underlying contour of the data very well. Figure 16 shows the improved results compared to using a moving average smoother with a rectangular or triangular window.

Find peaks and valleys

The “Find” function can be invoked by right clicking on the analysis values chart window. The “Finding Frames of Maximum and Minimum Contact “ section of the AAA manual describes the components of the “Find” dialogue and provides an example of a function to find EPG closure regions. This section will describe functions useful in the analysis of EMA data.

Finding a region 10% either side of a peak.

This can be applied to displacement or tangential velocity traces for a given EMA sensor.

Stage 1 Find peak in EMA Tongue Blade Tangential Velocity (TB2 Tang Vel) within 50ms either side of where the mouse is clicked

Search Analysis Value
Analysis: TB2 Tang Vel

Get Selection
Name it: Sel
 Save

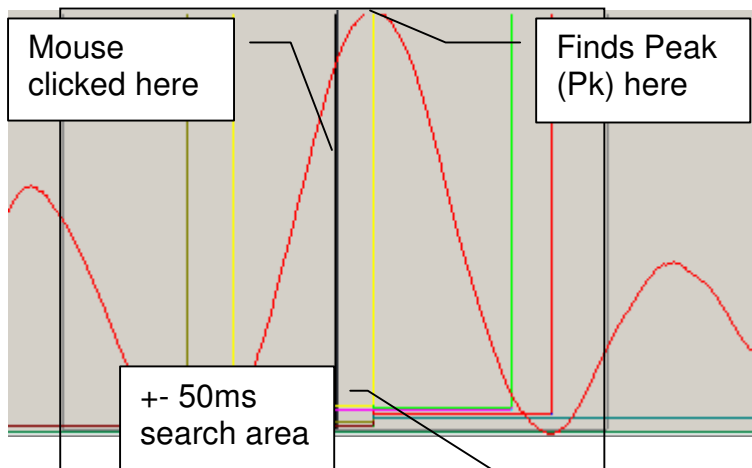
Create Region
Name it: Sel100
Start at: Sel Start
-50 mSec Later
End at: Sel End
50 mSec Later
 Save

Set Search Area
 Search Area is whole recording
 Search Area is current selection
 Search Area is Sel100

Find Peak/Valley
Find: Peaks Valleys
Which: Biggest First Last
Named: Pk
 Save

Change these to -20 and 20ms for a tighter peak search

Change this to "Sel" if you want to search for the peak within a manually selected region

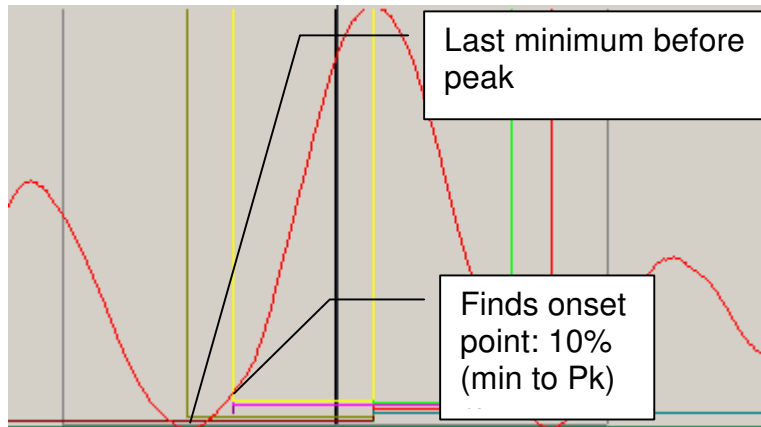


Stage 2 Find last valley before the peak
Search a region 10 seconds before the peak and find the last valley in this region.

Create Region
Name it
Start at Start
 mSec Later
End at End
 Save mSec Later

Set Search Area
 Search Area is whole recording
 Search Area is current selection
 Search Area is

Find Peak/Valley
Find Peaks Valleys
Which Biggest First Last
Named
 Save



Stage 3 Find the “Onset” point 10% of the way from the valley to the peak
Define a region starting at the valley and ending at the peak set the variable V to the value

The screenshot displays three panels from the software interface:

- Create Region:** Name it: min-to-pk; Start at: pre-min; End at: Pk; Save: .
- Set V:** Region: min-to-pk; V: 10 % of height. The '10' is circled in red, and a callout box points to it with the text "Change this % value to your preference".
- Find Shoulder:** Name it: onset; Start at: Pk; Look: Before; Value is: V.

Stage 4 Repeat stages 1-3 to find 10% “Offset” point up from the first valley after the peak.

The screenshot displays two panels from the software interface:

- Create Region:** Name it: Post-search; Start at: Pk; End at: Pk; Save: 10000 mSec Later.
- Set Search Area:** Search Area is: Post-search.

Find Peak/Valley

Find Peaks Valleys

Which Biggest First Last

Named

Save

Create Region

Name it

Start at Start

mSec Later

End at End

Save mSec Later

Set V

Region

V % of height

Find Shoulder

Name it

Start at

Look Before After

Value is

Value

Percent of Start

Above Start

V

Save

Stage 5 Annotate the regions onset to peak, peak to offset and onset to offset.

Create Region
Name it
Start at Start
 mSec Later
End at End
 Save mSec Later

Create Region
Name it
Start at Start
 mSec Later
End at End
 Save mSec Later

Create Region
Name it
Start at Start
 mSec Later
End at End
 Save mSec Later

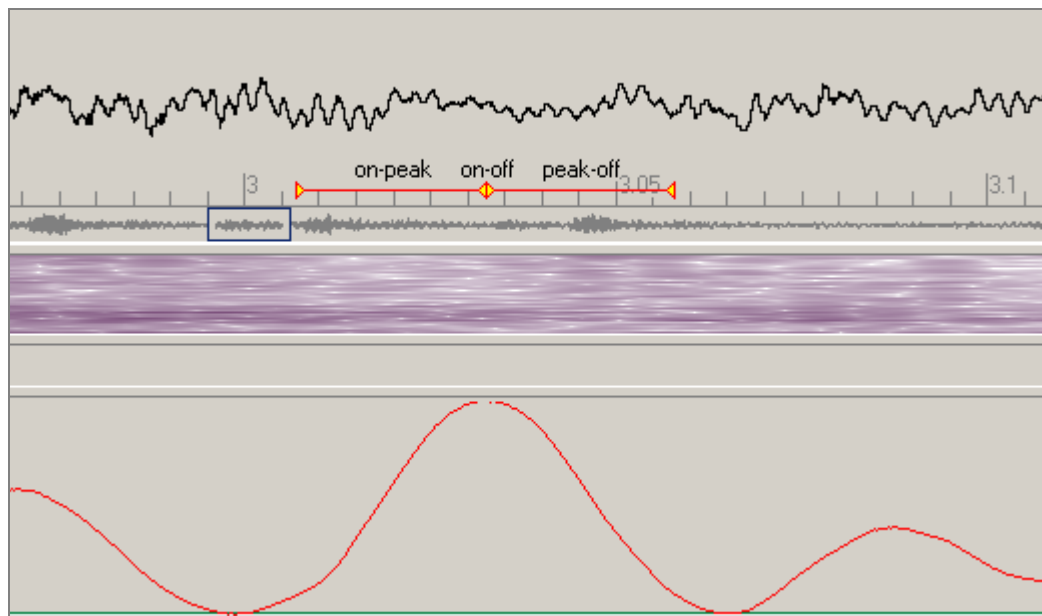


Figure 17 Result of executing the “Percent of peak region” Find script

Shortcut Keys

Help	F1
Playback	F2
Record	F3
Select visible region of waveform	Ctrl+A
Adjust selected region/ selected annotation	Ctrl + drag mouse
Select region in Palates or Analysis values windows	Shift + drag mouse

Revision	Date	Notes
2.13	19/05/11	Importing AG200 data instructions

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