# SPME 430 Biomechanics

## Data Tracking - Motion Analysis System
## Computation of 3D Coordinates

In the previous lab, we learned the methods required to collect video data on markers affixed to the body. In this lab, we will transform the video information from the six cameras, stored in computer data files, into a single set of 3D coordinates for each marker at each instant during the data trials. This process is referred to as data tracking.

### DATA TRACKING

1. Turn on the following items
   A. Dell computer monitor

2. Turn on the peppermint computer.
   A. Select the first option during startup (Select Windows 2000 Operating System) by pressing the Enter (↵) key or wait for the timer to count down.
   B. Allow the system to start. When the start up is complete, you will see a screen that says "press CTRL-ALT-DEL to log on".
   C. **CTRL-ALT-DEL**
   D. Enter your user name. The user name for our class is SPME430
   E. Enter your password. The password for our class is Biomechanics
   F. **OK**

3. A. If the Midas Computer is on and the EVa software is running on Peppermint, skip to step 5.
   B. If the Midas Computer is off and the EVa software is not running on Peppermint, Double-click the "Eva7.0_No Midas" icon on the peppermint computer's desktop.

4. Window “EVa 7.0 3D/2D” will appear. This is the main EVa window.

5. **File – Load**
   A. File Type – Project
   B. Select correct project file from the file list by single clicking on the file name. The file name will appear in the Selection box.
   C. Load – Complete Project
   D. **Load Project**

   For this project, your project name is _____.

6. You should get the message – “A complete Project has been successfully loaded” at the bottom of the Eva Load Files window. If not, repeat step 5.

7. A. **File Type – Trial**
   B. Select correct trial name from the file list by single clicking on the file name. The file name will appear in the Selection box.
   C. **Load – Trial**
   D. The EVa 3D Visualization/Tracking Tool window will open automatically if the trial is loaded successfully. If not, repeat step 7.
   E. **Close**

8. Switch to the EVa 3D Visualization/Tracking Tool window.

9. Use the top slider bar or the buttons to observe the motion (the slider bar is easier to use). You can change the view by clicking on the diamonds next to each camera number. Observe the motion until you are familiar with the area of interest and have identified the frame at which you wish to start computing 3D coordinate data and the frame at which you wish to stop computing 3D coordinate data.

10. Initialize the Tracking Parameters
    A. Use the slider bar to position the image on the first frame at which you want to compute 3D coordinate data and start the detailed analysis. This is termed the low frame.
        i. **Low Frame - Current Frame** or CTRL-Z
    B. On this same frame or image, set the start frame (this is also done by default)
        i. **Start Frame - Current Frame** or CTRL-X
    C. Use the slider bar to position the image on the last frame for which you want to compute 3D coordinate data and stop the detailed analysis. This is termed the high frame.
        i. **High Frame - Current Frame** or CTRL-C

11. **Track - Track All Frames**

12. A new window will be displayed that now shows the 3D coordinates of each marker. You can use the Front (YZ), Side (XZ) and Top (XY) buttons to change views as needed. You will usually want to start with a Side View. Change to a Side View now by clicking on the box labeled Side View (XZ).

13. If the dots that represent each marker appear very large, click the box next to the Show Depth button. This box should be white not gray.

14. **Begin Display - Low Frame**

15. **End Display - High Frame**

16. <<

17. **Identify - Quick Identify**

    A. The Quick Marker Identification window will open.
    B. Use the mouse to position the cursor on the marker that is listed in the Quick Marker Identification window and left click on the marker. The number of the marker will be displayed next to the marker in the image window.
    C. Repeat this until you have identified all visible points.
    D. The marker window will close automatically when all points have been identified.
    E. In neutral or stationary trials, you will need to identify all markers. In the movement or "real" trials, you will only identify the markers that remain on the subject after the neutral trial or stationary markers will have been removed. Thus in movement trials, you will not be able to identify the neutral trial markers and will have to manually close the Quick Marker Identification window (left click on the "X") when you have completed identification of all "normal" or non-stationary trial markers.

18. **Track - Rectify Tracks**
    If you are asked to set the current frame to the start frame, answer YES.

19. Use the slider bar to view the tracked markers. You should now see a line that connects the positions of the tracked markers on each segment. However, you may see these lines disappear for portions of the trial. We need to address this possible problem.

20. In the EVa main window, **Edit - X,Y,Z Time Series**. A new window will open (EVa 3D Time Series Editor) that will display 4 windows on the screen. The top three windows will provide graphs of the X, Y and Z coordinates of the markers versus time, respectively. We will begin the process of data editing.

21. Data Editing
    A. Look in the lower right hand corner of the screen in the unnamed path window. Are a large number of the unnamed paths blue? (All blue paths indicate that coordinate data are present in the path; black paths contain no data and can be ignored.) If you have a large number of blue paths (> 6), you have probably made errors during data collection or tracking. In this case, it will be best to close this window, return to step 7, reload the trial data (no, you do not want to save tracked data; yes, it is ok to clear current tracks), and start tracking again. If you have only a few unnamed tracks, continue.
    B. ALL - **ON**
    C. Observe the 2 slider bars at the bottom of the window.

       If you click and drag on the button in the top slider bar, you will see that an orange line moves across the data windows and that this line appeared initially from the left side of data windows. Will we use the top slider bar to define the beginning of specific time intervals within the data set and call the orange line associated with this slider bar to be the starting line.

       If you click and drag on the button in the bottom slider bar, you will see that an orange line moves across the data windows and that this line appeared initially from the right side of data windows. Will we use the bottom slider bar to define the end of specific time intervals within the data set and call the orange line associated with this slider bar to be the finishing line.

D. Use the top slider bar to position the starting line just to the left of the coordinate data (i.e., just before the data are computed).
E. Use the bottom slider bar to position the finishing line just to the right of the coordinate data (i.e., just after the data are computed).
F. *Right click* - **ZOOM**. The data should now fill the windows.
G. ALL - **OFF**
H. In the right hand window, click on the name of each marker and its data will be displayed in the data windows.
I. Observe the X, Y and Z coordinate data for each marker. Are there gaps or holes in the data. If so, record the name of the marker.
J. In the right hand window, click on the name of the marker to remove its data from display.
K. Repeat Steps H through J until you have viewed all markers and recorded the names of all markers with gaps in the coordinate data.
L. Click on the name of the first marker that had gaps in its coordinate data.
M. In the unnamed marker window, click on the first BLUE unnamed marker path.
N. Do the unnamed (blue) coordinate data appear to "fit" into the gaps with the marker coordinate data?
    i. If yes, position the starting and finishing lines so that they fall within the gaps of the marker coordinate data and at the beginning and end, respectively, of the unnamed coordinate data.
        a. *Right click* - **EXCHANGE**
        b. Unnamed - **OFF**
    ii. If no, click on the name of the current unnamed path to remove this data from the display and try a different unnamed path. If the gap is large, the data in the unnamed paths should fill the gaps in the marker coordinate data.
    iii. Repeat the processes in step N until you have tried to fill the current gap with all unnamed data paths.
    iv. If no unnamed data will fill the gap in the marker coordinate data or once you have completely filled all gaps in the coordinate data, proceed to the next step.
O. Proceed to the next marker that had gaps in its coordinate data.
P. Repeat the processes outlined in Steps M through O until you have "filled" as many gaps as possible in the marker coordinate data and no "significant" gaps remain in the marker coordinate data. At this point any remaining unnamed paths should contain a very small amount of coordinate data.
Q. All - **OFF**
R. Unnamed - **ON**
S. Position the starting and finishing lines so that they are just beyond the left and right edges of the data display windows, respectively.
T. *Right click* - **CUT INSIDE**
U. All - **ON**
V. Move the starting line so that it is at the first data frame.
W. Move the finishing line so that it is at the last data frame.
X. *Right click* - **JOIN**

Y. If you are directed to smooth the coordinate data, follow the steps below.
   i. *Right click* - **SMOOTH**
   ii. Enter the desired cutoff frequency in the box. This will be assigned to you in lab.
   iii. **OK**

Z. It is imperative that before you finish editing the coordinate data, you double check to be certain that no data are missing for any marker during the analyzed portion of the trial. If only a few frames are missing at the beginning or at the end of the trial, you can do the following to "fix" the problem
   i. All - **ON**
   ii. Move the starting line to the first frame where all markers have coordinate data. Now move the starting line one frame to the left.
   iii. Move the finishing line to the last frame where all markers have coordinate data. Now move the finishing line one frame to the right.
   iv. *Right Click* – **CUT OUTSIDE**

   If coordinate data are missing during the middle of a path, then you have done something incorrectly. I suggest that you return to step 21A and try again.

AA. Close the EVa 3D Time Series Editor window.

22. Use the slider bar to view the tracked markers. You should now see a line that connects the positions of the tracked markers on each segment. There should be no missing lines or markers at this time throughout the entire analyzed portion of the trial.

23. Close the EVa 3D Visualization/Tracking Tool window.

24. In the EVa main menu

   A. **File - Save Tracks - 3D Binary (*.trb)**
   B. Make certain that the box next to discard unnamed trajectories is gray
   C. **Save Tracks**
   D. If you get a message saying "Track 1 is missing data at frame 1" - **OK**
   E. **OK**

25. Return to Step 7 to track additional trials.

26. *If you have not collected data during this session (i.e., only tracked previously collected trials), skip this step.* Otherwise, save the project data. In the Eva Main window:
   A. **File - Save Project**
   B. You will get message indicating that the project was saved.
   C. **OK**

27. Close the Eva Main window. *Press the X in the upper right-hand corner of the window.*

28. **YES**

29. If you are done using the Motion Analysis System and someone is waiting to use the system (you only want to log out of the system), go to step 30.

    If you are done using the Motion Analysis System and no one is waiting to use the system (you want a complete shut down of the system), go to step 31.

30. A. **CTRL-ALT-DEL**
    B. **Log Off**
    C. **OK**
    D. You should see a screen saying "press CTRL-ALT-DEL to log on". If so, you have logged off successfully and can allow the next user to have access to the system.

31. A. **CTRL-ALT-DEL**
    B. **Shut Down**
    C. **Shutdown**
    D. **OK**

32. Turn off all items listed in Step #1 and Step #2.

33. Close & Lock the door to the lab on your exit.