ME/BIOE 481. LAB 1: Stability

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1 Critical info

- Due date: February 15, 2021 - 1PM (US Central standard time)

- You may work in pairs. Include your names at the top of your lab report. You and your partner will receive the same grade. Only one person needs to turn in the assignment to compass. It can be neatly handwritten or typed (typed is preferred for text). Let the pride in your work show in the quality/legibility of the assignment you turn in. Illegible writing or poor scans/uploads will not be graded.

- Show all work!

2 Introduction

We have learned that stability and balance are processes associated with coordinating the position of the center of mass. The inverted pendulum model for quiet standing tells us that the acceleration of the center of mass is proportion to the changes in the position of the center of mass relative to the center of pressure. Neuromuscular control and proprioception is also an important component of stability. In this lab, you will use video analysis to measure your postural sway during quiet standing under two conditions: eyes open and eyes closed.

3 Materials Required

1. Tape

2. Sticky note (bright color) or bright colored paper

3. Something to record your video with (cell phone camera or laptop camera)

4. A ruler (for scale reference)

4 Before Recording

1. Select a subject for your experiment (either you or your partner). Record their height and mass.

2. Choose a location for this experiment that allows a sagittal view of the body.

3. Set up your camera system so that the entire lower extremity (including hip) is visible within the field of view in the sagittal plane. Mark this position on the ground - an easy landmark is to place an object or a piece of tape at the front of your feet.

4. Marker placement: you will use a paper marker to track your center of mass and your ankle. Make sure the marker is brightly colored and contrasting to your clothes so that it will be easy to track.

   Center of mass: Place a marker on your hip. Make sure the marker is attached firmly such that it will not come off/move during the process of video recording.

   Ankle: Place a marker on the lateral mallelous of your fibula. https://en.wikipedia.org/wiki/Malleolus

   You will also need a ruler or an object of known length to be placed beside you standing upright. This is critical as **Tracker** needs a reference to calibrate.

5   Stability trials

1. Create a randomized order of six trials - three with your eyes open and three with your eyes closed.

2. Stand in the position identified above with arms crossed over the subjects chest and your hands near the shoulders. Remember to place a ruler/calibration object in the field of view.

3. For each trial, record a video of the subject during quiet stance for 10-15 seconds. At the end of <u>each</u> trial, walk around for a minimum of 30 seconds.

6   Digitizing markers

Tracker is a free software which can be downloaded from **here**. The following tutorial videos will be very helpful to get you started.

- **Tracker Quick Start**

- **Autotracker Tutorial**

1. Open Tracker software and open one of the video files by clicking on File > Open File.In case your video is in landscape orientation, you can rotate the video to the orientation you like by clicking on options from Video tab.
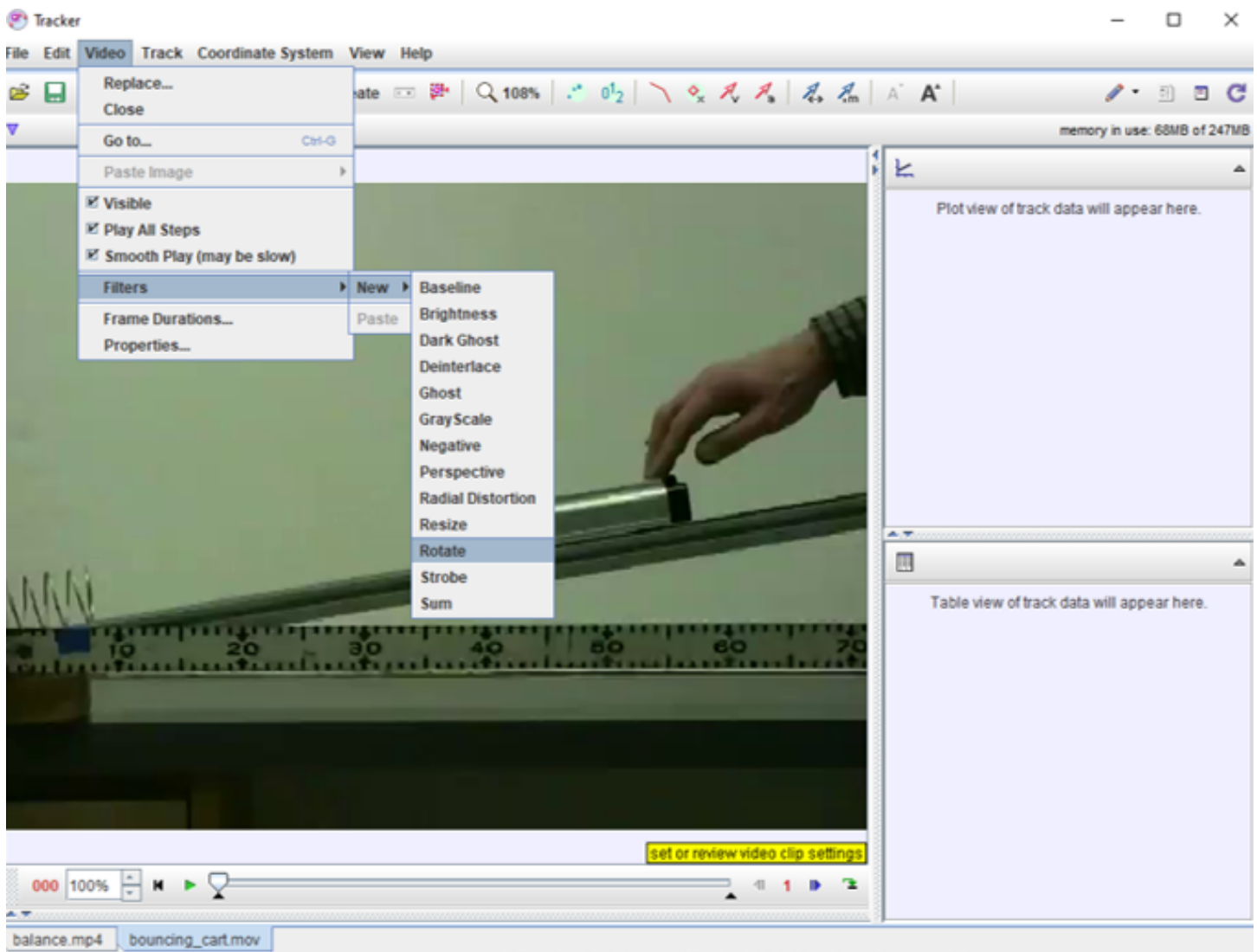
2. Once you are satisfied with the orientation of the video, you need to calibrate the video. Follow the instructions from **Tracker Quick Start** to calibrate your video by entering the length of the scale you used.

3. By dragging the black triangles at the bottom, you can set the start and end frame for the analysis and decrease computation time.
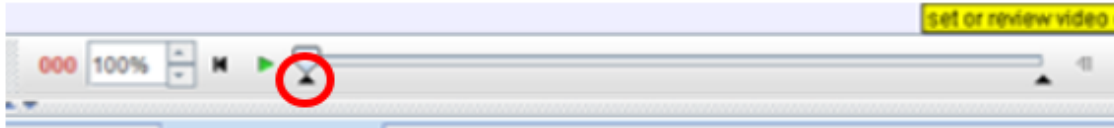

4. Following the instructions from **Tracker Quick Start** set the origin by clicking on the center of the marker you used. Click the button again to hide the axis.
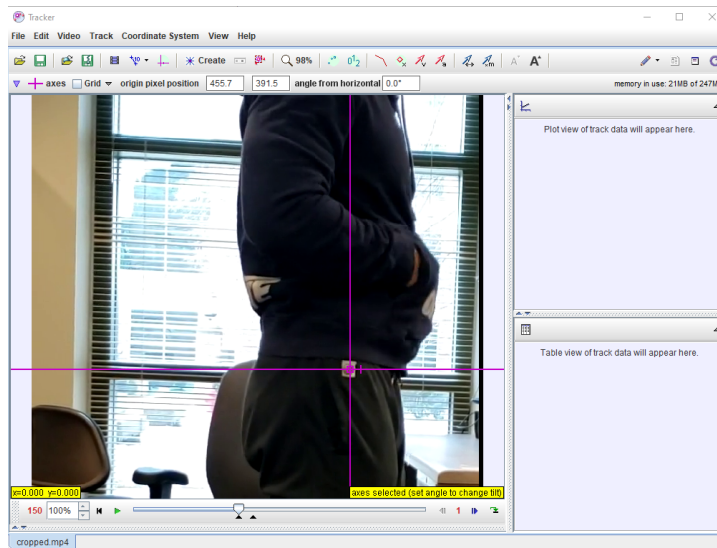
5. Create a point mass to be tracked (marker you attached to your hip or ankle) by clicking on Create > Point Mass. You will see a Track Control dialog box pop up.
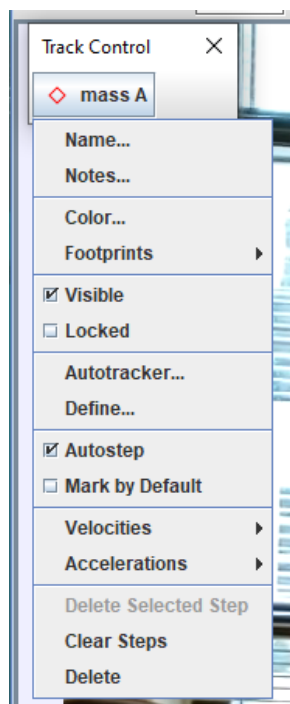
6. We will be using Autotracker function to track the hip marker. Click on mass A button and then click the Autotracker button on the toolbar.You should see the Autotracker settings dialog box pop up.
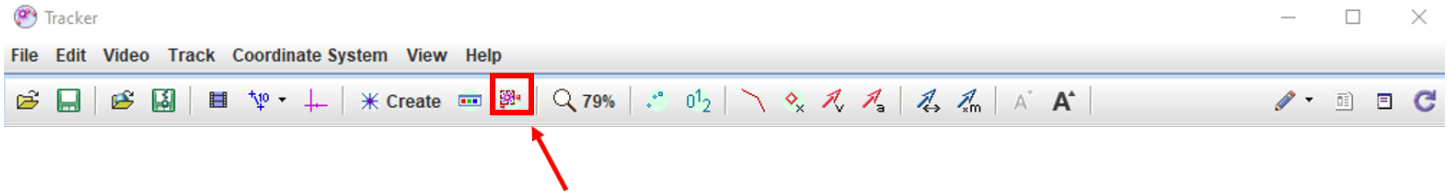
7. Hold Shift+Ctrl an click on the hip marker (region of interest) to be tracked. For Mac, it is probably Shift+Command.

8. After you have clicked on the region of interest, you will see a square region around your marker. The smaller this region is the better the tracking will be. Resize the square such that it matches the size of the marker you have on your hip.Make sure the video is set to the starting frame and not the ending frame in this step. If it is at the end frame, Autotracker will give you an error.

9. In Autotracker settings box, click on Search. You should see your video playing and the point marker moving along with your physical hip marker.

10. Repeat steps 5-9 for ankle marker. The software can easily track two markers.

11. On the right side of software window, you will see the data being plotted in real time. This will stop automatically after the video has ended. The default is Time vs. X position. Your goal is to see X position vs. Y position plot. You can change this by right clicking on the respective data in the plot.Since you are tracking two masses (A and B), the data section will let you choose between two masses.

12. Click the "table" button to select both x and y, and they will show up in the table

t (s)	x (m)	y (m)
1.107	-19.04	-0.333
1.200	-15.68	-0.955
1.233	-10.82	-0.936
1.267	-5.027	-1.152
1.300	-0.322	-1.848
1.333	5.202	-2.152
1.367	8.260	-2.628
1.400	11.75	-3.001
1.433	15.14	-2.975
1.467	17.26	-3.646
1.500	19.68	-3.402
1.533	21.61	-3.275
1.567	23.47	-3.031
1.600	25.19	-2.811
1.633	26.90	-1.842

13. Make sure you have both x and y data shown in the table. Right click anywhere in the plot section and select Analyze. You will see a new window with just the plot. Select all the data points in the table and then you can export your data by clicking File > Export Selected Data . You can export your data in txt or xml format. Make sure to name your data files so that you can distinguish between the trials and conditions clearly.

14. Take a screenshot of the plot for each trial. You will be comparing this plot with the plots from MATLAB.

7   Data Analysis

You will be importing your data into MATLAB for analysis and comparing the plots generated from your MATLAB code with the plots from Tracker. The goal of the analysis is to (1) calculate the mean, standard deviation, and

range of the center of mass in the anterior-posterior direction and (2) determine if there is a difference in having eyes open or closed during quiet stance.

Below are some suggestions for how to analyze your data in Matlab.

1. Open Matlab and create a script. It may be helpful to set the path to the location of your data.

2. Before loading the file, pre-set the name of the file so that you can create a loop to read the txt files automatically. For example: name1 = 'mass-A'

3. Use the 'importdata' function to load the text files - this results in a structure in Matlab with the data.

4. Use the 'hold on' function to overlay plots from each trial (showb below). Alternatively, use 'subplot' to make 2 plots.
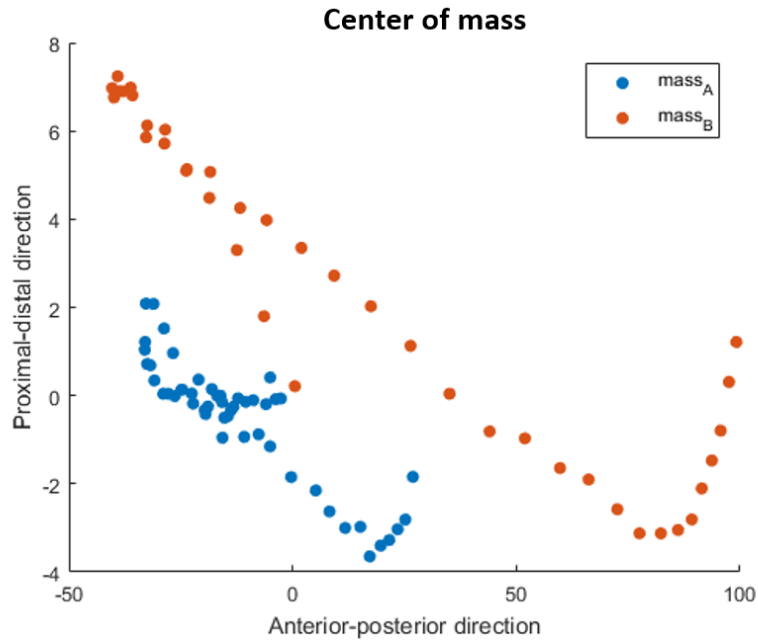
5. The following functions might be useful: 'mean', 'range', and 'std'.