Pre-Lab 04: Using Tracker for conducting video analysis

In lab this week you will be using an online video analysis tool, called Tracker, to collect acceleration data for a moving object. Tracker is relatively easy to use and this pre-lab has been designed to help you learn about the tool before lab.

Learning Objective:

- Use Tracker on own device to determine the acceleration of a moving object via video analysis

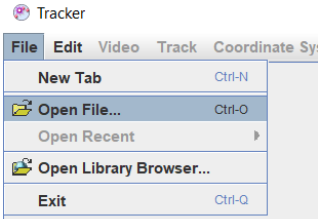
Work completely through the instructions in this document. When you are finished, you will upload a screenshot as your pre-lab quiz this week. **Although we expect this to be an easy task, please do not wait until the last minute in case you run into issues!**

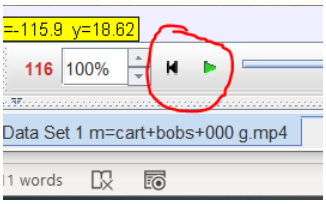
1. **Download** onto your computer the video in the pre-lab 04 folder on Canvas. This is the video you will be analyzing in Tracker.
2. **Open** the Tracker Video Analysis and Modeling Tool at https://physlets.org/tracker/
3. **Download** Tracker by choosing the appropriate option on the screen:

   Tracker 5.1.5 installers: Windows OS X Linux 32-bit Linux 64-bit

   Already have Tracker? Upgrade now to version 5.1.5: Windows OS X Linux 32 Linux 64

4. Once in Tracker, use the Open File option (see right) and open the video file you downloaded in Step 1.
   - If the screen is dark, hit the play button at the bottom of your screen as the video may be starting on a dark section.
   - **Change size.** Use the magnifying glass on the tool bar above the video to pan out so you aren't able to see the full set up.
   - **Play the video** a few times to understand the event on the video. You will need to click on the Rewind icon (see right) under the video to return to the start frame:





5. **Trim the video.** In lab you will be analyzing similar videos to determine the acceleration of the system (cart/string/red fish bobs). However, you only need a small segment of the video where the objects are actually moving. In addition, you will notice that the camera is only directly in front of the red fish bobs at the top of their path, and that as they fall the camera begins to view them from an angle. This is referred to as parallax and will result in inaccurate data. Therefore, you need to trim the video to the small segment from the instant the red bobs begin to fall (Figure 1a) to when they are just below the table (Figure 1b). You will get a feel for this in lab so don't worry about it too much now. See the next page for instructions on how to trim the video.

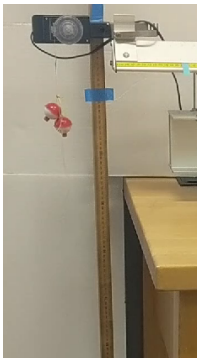


Figure 1a.

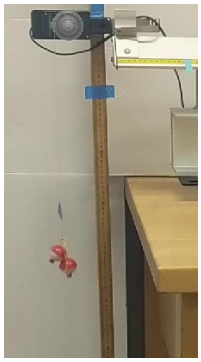
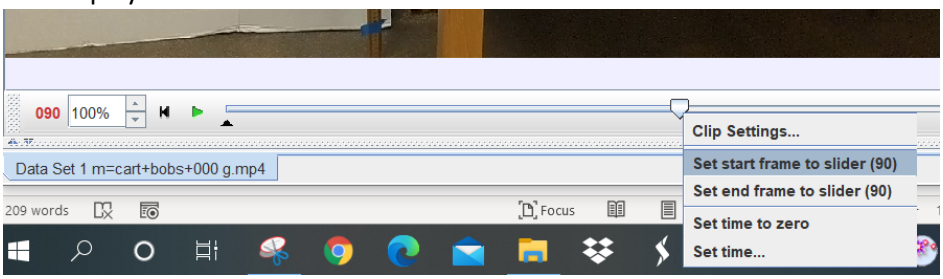
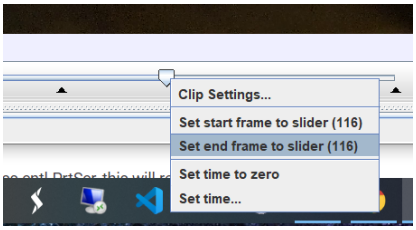


Figure 1b.

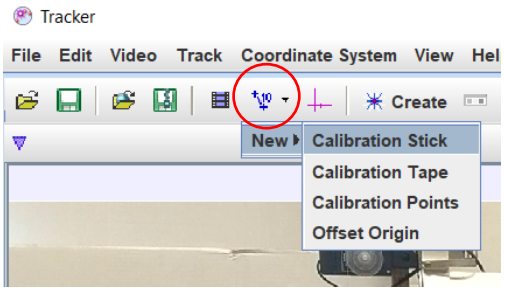
- **Set start frame.** Drag the slider under the video until the moment you wish to start the video. Right click on the slider and chose the "Set start frame to slider" as shown below. The small black triangle under the play bar will move to that location.



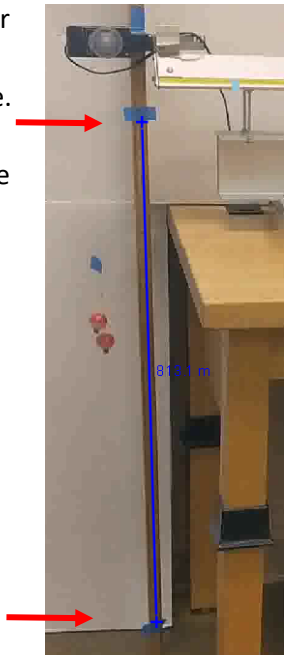
- **Set end frame.** Repeat for where you wish to stop the video (see figure 1b) but this time choose "Set end frame to slider" as shown at right.



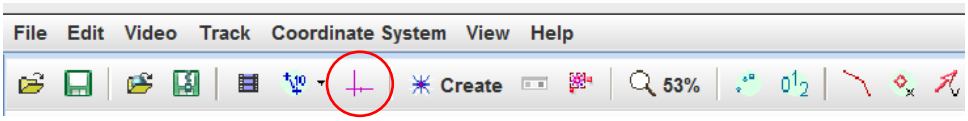
6. **Calibrate video distance**. There is a long stick placed in the background near the plane of motion of the falling bobs. A piece of blue tape has been placed at the top and bottom 1 meter apart. Tracker needs to be calibrated using this measurement.
   - Use the drop down arrow near the Calibration icon shown in red circle below. Select "Calibration stick".



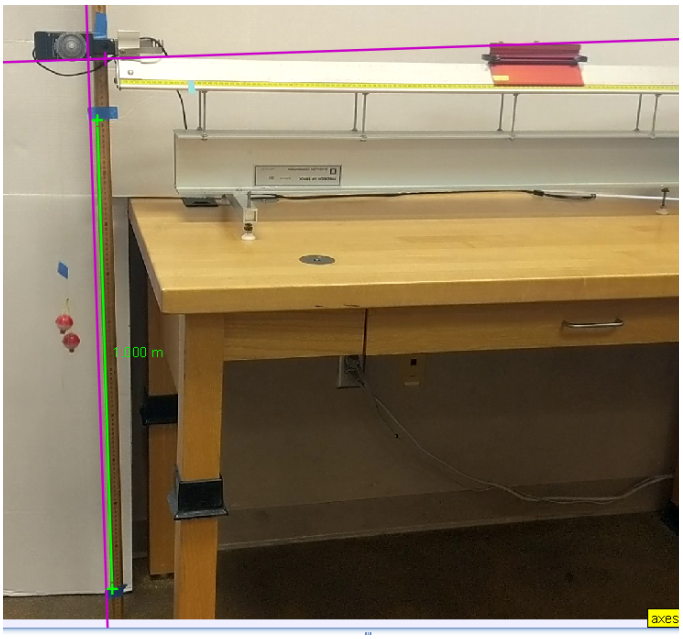
   - Now, hold down the SHIFT KEY on your computer. You will notice the cursor on your screen changes. Move the cursor to the bottom edge of the blue tape near where the bobs start below the pulley and RIGHT click the mouse. A marker is placed here.
   - Repeat for the top edge of the tape at the bottom of the screen. A blue line connecting the two will appear.
   - The distance marked along the side of your calibration stick is not correct. Click on it and change the value to 1 m (Tracker will change it to 1.000 m).



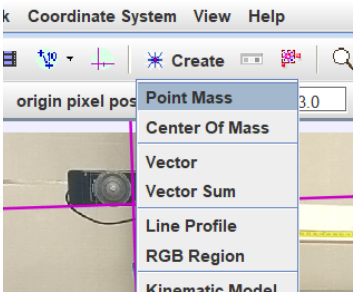
7. **Set origin and axes tilt**. Click on the axis icon on the top tool bar (in red circle below). A purple axes will immediately pop up on the screen.



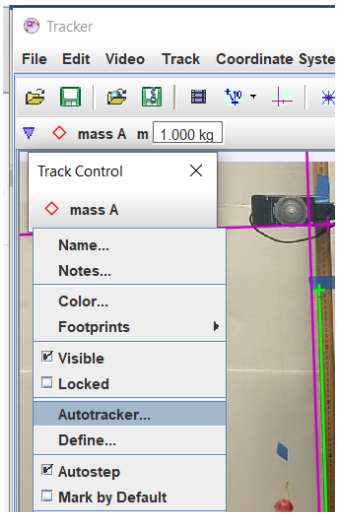
- **Move the axes.** Drag the center of the axes to some point above the upper blue tape (see below). The vertical location of this point isn't critical as long as it is above the bobs in their starting position.
- **Position the y-axis.** The x-axis will appear parallel to the track for the cart but not to the motion of the falling bobs. This is the result of parallax given the camera angle! Because we are interested in measuring the acceleration of the falling bobs rather than the cart (this choice was made due to the camera position), the axes need to be rotated such that the y-axis is parallel to the long stick in the background (path of the falling bobs). The axes can be titled by dragging the +x axis up or down.



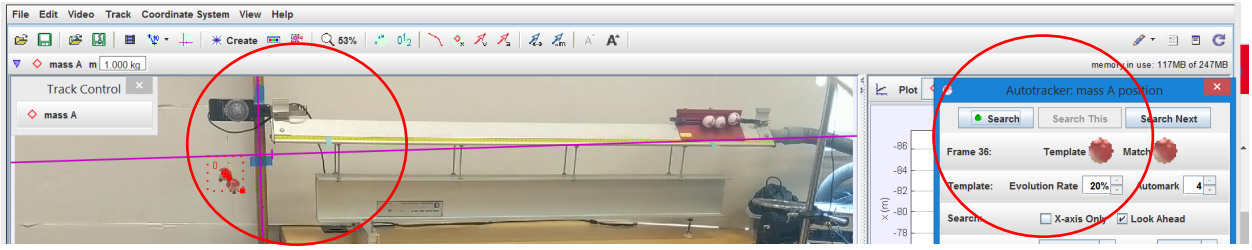
8. **Tracking a falling object**. Once everything is set up and calibrated, the next step is to engage in analysis of the video.
   - **Create a point mass.** Click on "Create" in the top tool bar as shown on the right. Select "Point Mass". A "Track Control" box with Mass A in it will pop up in the upper left corner.



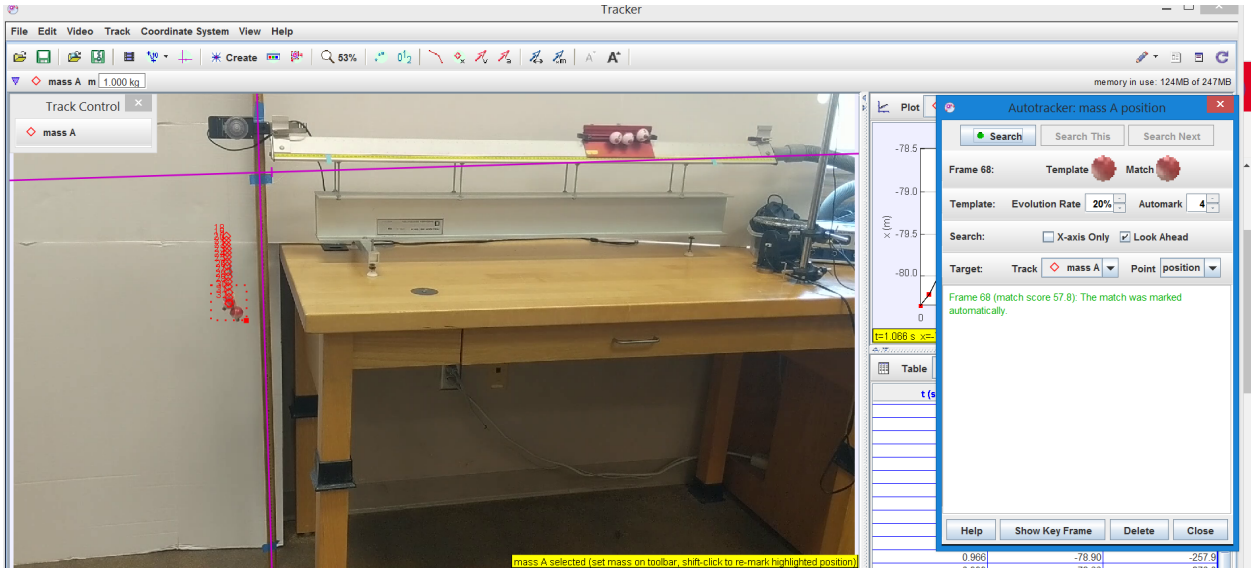
   - **Enable Autotracker.** Click on Mass A in the Track Control box. Choose Autotracker.



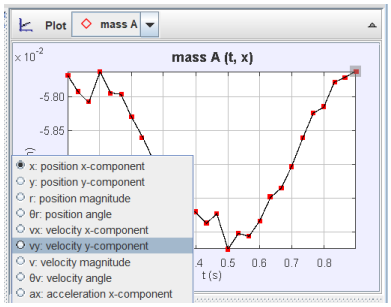
- The software needs to be told what object to track. Simultaneously hold down the SHIFT and CONTROL keys and then use your mouse to click on one point of the object (bobs). Try to pick a point that will be easy for the system to track. See the large red circle on the left.



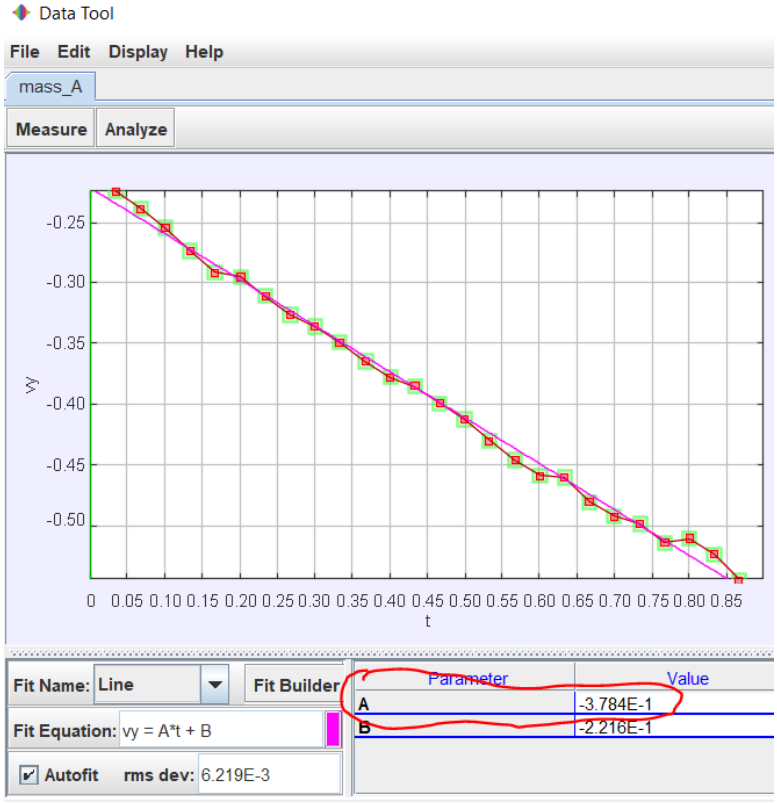
- Now click on Search button (see the red circle on the right above).
- Tracker will automatically play the video and track the motion of the falling bobs frame by frame. See below. Notice the graph and data table that are generated by Tracker during the motion. Close the Autotracker window so they can be seen. If it doesn't automatically track, you probably have the video at the end. Reset the video or manually move the slider back to the start frame. Hit the Search button again.



9. **Determine the acceleration.** The graph that is generated is a position vs time graph. A velocity graph is needed to determine acceleration. Click on the x(m) on the y-axis and select the 6th option down which is "vy: velocity y-component" (see below).



- Double-click in the white space of the graph window to bring up the Data Tool window, which will look like that below when it pops up.
  - From the top menu choose “Analyze” then “Curve Fits”.
  - Below the graph there is the option to change the fit. Line is the default, which is what you want so there is nothing to change.
  - The equation of the line is given as vy=A*t + B and the values of A and B are provided. Remember that acceleration is the slope of a velocity versus time graph so the value of A in the table below the graph is what you needed!
  - If you feel that the data shown on the graph has data you wish to exclude, you can drag your video play button and trim the video and get a new, hopefully more accurate, value for the acceleration.



- Take a screen shot of your ENTIRE screen, not just the graph. Copy and paste it into a Word file and upload it to Canvas under Pre-lab Quiz 04. Keep a copy of these instructions on your computer for use during lab this week.