College Physics – Summer 2014

Lab 2: Video Analysis of Motion

Goals: Improve communication and teamwork capacities**;** Improve ability to record notes; Improve confidence using computers; Start learning to use analysis tool LoggerPro; Start learning to perform video analysis; Apply video analysis to constant velocity and constant acceleration motion along a straight line; For constant velocity situations, use the slope of the position vs. time graph to determine the velocity; For constant acceleration situations, use the slope of the velocity vs. time graph to determine the acceleration.

Equipment: Your primary tool today will be the computer. You can find a keyboard and mouse for your computer in the top drawer. These are paired with that particular computer, so take precautions not to mix them up. If the keyboard or mouse doesn't interact with the computer, make sure they are turned on. The videos for today's video analysis are located in the program share, under Handouts, and then in the Lab 2 folder.

Groups: For today's investigation, you will work in individually at your own computer.

References:

- LoggerPro tutorials 01 Getting Started, 07 Viewing Graphs, and 12 Video Analysis, available under LoggerPro, File: Open: Tutorials.
- Video Analysis for LoggerPro, available in the program file share, under Handouts: Lab 2.

Part 0. Lab Notebook

- Your name and contact information should be written prominently and early.
- You should leave room for a Table of Contents. If you have already begun to write on the first page, then you can insert a separate sheet of paper for a Table of Contents; ask how if you are uncertain.
- Each new lab should begin on a new page, and start with the title of the investigation. You should also include the names and contact information of any lab partners.
- It's a good idea to leave some room at the end of each lab entry in case you need to add something later.
- For this lab, you should leave sufficient space at the end to tape in the graphs which you will print out later when you have access to a printer and then tape directly into your lab notebook.

Part 1. Video Analysis, Motion Diagrams, Motion Graphs

As a class, you will be introduced to video analysis. By the end of the introduction, you will be shown how to do the following. On completion of this lab, you should be able to do all the things on this list. Nearly everything on this list is covered in the References above.

- ☐ Find and launch LoggerPro, Insert a Movie, and Play the video
- ☐ Turn on the Video Analysis tools
- ☐ Set the scale to convert screen coordinates to world coordinates
- ☐ Add points to make a Motion Diagram, toggle trails to show or hide points, and delete a point
- ☐ Use Movie Options to set the frame advance
- ☐ Set the Active Point to track more than one object
- ☐ Make a Position vs. Time graph and a Velocity vs. Time graph
- ☐ Find and show best fit lines on graphs
- ☐ Copy graphs into a separate document for later printing
- ☐ Save LoggerPro files to your Cubbie

a) Together, we will analyze the video One Buggy (source: J.A. Bryan, Ball State University). All videos are available in the program file share, in Handouts: Lab 2. You will need to make sure that you in LoggerPro, you use Insert: Movie to open the video from within LoggerPro.
b) Leave space in your lab notebook to tape in the position vs. time graph later.
c) Analyze the position vs. time graph for the buggy to determine its velocity.
d) Analyze the velocity vs. time graph for the buggy to determine its velocity, and compare to part c).
e) Save the (usefully named) LoggerPro file to your Cubbie.

Part 2. Slowing Down (source: J.A. Bryan, Ball State University)

a) Here, we will again examine together a situation with non-constant velocity.
b) Re-launch LoggerPro, and use Insert: Movie to insert the video Slowing Down. Watch the video a few times (straight through and using the scroll bar at the bottom of the video player screen).
c) Produce a motion diagram.
d) Produce/examine the position vs. time graph (since the motion is in the x direction, this is an X vs. time graph; remove the Y data since it is not important in this case).
e) Produce/examine the velocity vs. time graph (since the motion is in the x direction, this is an X velocity vs. time graph; remove the Y data since it is not important in this case).
f) Analyze the velocity vs. time graph to determine its acceleration.
g) Save the (usefully named) LoggerPro file to your Cubbie.

Part 3. Two Buggies (source: J.A. Bryan)

a) Re-launch LoggerPro, and use Insert: Movie to insert the video Two Buggies. Reproduce the steps demonstrated in class to create motion diagrams for the two buggies. What do you notice about the spacing between the dots in the motion diagram? What does this indicate?
b) Analyze the position vs. time graphs for the two buggies to determine their velocities. Comment on the signs of the slopes.
c) Save, etc.

Part 4. Toy Truck (source: J.A. Bryan)

a) Re-launch LoggerPro, and use Insert: Movie to insert the video Toy Truck. Note the non-standard frame rate for this video, indicated in the first frame. You can adjust for this using Movie Options (right click on the movie) and then Override frame rate to: .
b) Produce a motion diagram and examine the position vs. time (just X) and velocity vs. time (again, just X velocity) graphs. Is the Toy Truck moving with (nearly) constant velocity? With (nearly) constant acceleration? If so, determine the velocity or acceleration.
c) Save, etc.

Part 5. Ball Toss (source: J.A. Bryan)

a) Produce a motion diagram. What occurs here that hasn't occurred in your previous motion diagrams? (You may find it convenient to turn off the toggle trail while clicking so as not to be distracted by the points).
b) Reproduce the rest of the analysis as previously, noting that this time the motion is in the Y direction.

Analysis

1. Consider your results from Two Buggies. What evidence on the position vs. time graph supports the claim that the buggies moved at (nearly) constant speed? Which buggy moved faster? How does that show up in your position vs. time graph? How is the fact that the buggies are moving in opposite directions show up in your position vs. time graph?
2. Consider your results from Toy Truck. What graphical evidence supports the claim that the truck moved with (nearly) constant acceleration?
3. Consider the acceleration you found in Ball Toss. Is this suggestive of a familiar physical quantity?
4. Make connections (compare and contrast) the situations in Slowing Down, Toy Truck, and Ball Toss.

Applications and Extensions

Perform video analysis on the video When Will They Pass to answer the question: when will the buggies pass each other?

Challenge Problem

View the video Will They Collide. Will They Collide?