Video Analysis – Ball Tossed in an Elevator

Apparatus

Tracker software (free; download from http://www.cabrillo.edu/~dbrown/tracker/)
video: `elevator-toss.mov`

Goal

In this experiment, you will measure the motion of a ball tossed in an elevator. You will measure its motion in the camera's frame and will calculate its motion in the elevator's frame. You will determine if the elevator is an inertial reference frame or not.

Procedure

1. Download the video `elevator-toss.mov` . Import the video into Tracker. Make two separate tracks, one for the elevator and one for the ball. Note that the motion of the object is *in the reference frame of the stationary video camera* which we will call the *Home* frame.
2. Analyze the graph of y(t) for the ball and for the elevator.
3. What is the velocity of the elevator? Is it constant or non-constant? Explain your reasoning.
4. Is the velocity of the ball constant or non-constant? Explain your reasoning.
5. Does the ball ever fall? Explain your reasoning.
6. What is the acceleration of the ball? (Use a quadratic fit to y(t) graph.)

   All of your measurements above are in the *Home* frame. Let's define the *Other* frame to be the elevator and make the same measurements in the reference frame of the elevator.
7. Now, go to **Coordinate System→Reference Frame** and select the elevator as shown in Figure 1.

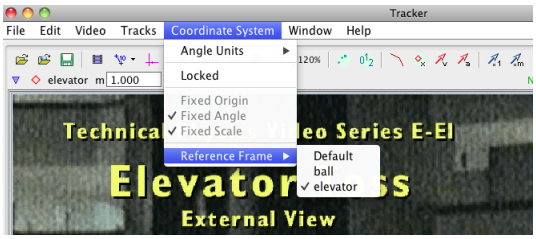

Figure 1: Change the reference frame to the elevator.

8. Analyze the graphs of y(t) for the ball and for the elevator.
9. Note the scale on the y(t) graph for the elevator. Explain the data on this graph.
10. In the *Other frame*, is the velocity of the ball constant or non-constant? Explain your reasoning.
11. Does the ball ever fall? Explain your reasoning.
12. In the *Other frame*, what is the acceleration of the ball? (Use a quadratic fit to y(t) graph.)
13. Describe the motion of the ball and sketch the path of the ball in the Other frame.
14. What measurements will observers in the Home frame and Other frame agree on?
15. Argue whether the Other frame is inertial or not. Provide evidence in your argument.