Video Analysis – Ballistic Cart

Apparatus

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

Goal

In this experiment, you will measure the motion of a ball shot from a cart. You will measure its motion in the "lab frame" and will calculate its motion in the cart's frame. You will determine if the cart is an inertial reference frame or not.

Procedure

1. Download the video `ballistic-cart.mov` . Import the video into Tracker. Make two separate tracks, one for the cart and one for the ball. Note that the motion of the objects is *in the reference frame of the stationary video camera* which we will call the *Home* frame.
2. Analyze the graphs of x(t) and y(t) for the ball and for the cart.
3. What is the velocity of the cart? Is it constant or non-constant? Explain your reasoning.
4. Is the velocity of the ball constant or non-constant? Explain your reasoning.
5. What is the acceleration of the ball?

All of your measurements above are in the *Home* frame. Let's define the *Other* frame to be the cart.

1. Now, go to **Coordinate System→Reference Frame** and select the cart as shown in Figure 6.

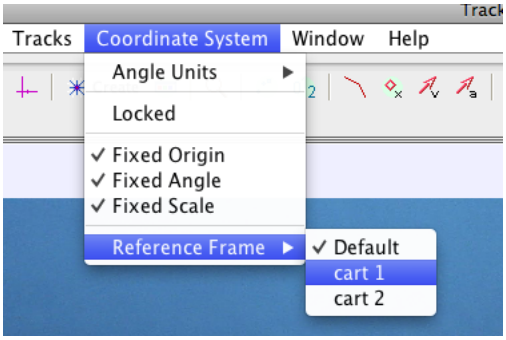

Figure 1: Change the reference frame to the cart.

2. Analyze the graphs of x(t) and y(t) for the ball and for the cart.
3. Note the scale on the x(t) graph for the cart. Explain the data on this graph.
4. In the *Other frame*, is the velocity of the ball constant or non-constant? Explain your reasoning.
5. In the *Other frame*, what is the acceleration of the ball?
6. Describe the motion of the ball and sketch the path of the ball in the Other frame.
7. What measurements will observers in the Home frame and Other frame agree on?
8. Argue whether the Other frame is inertial. Provide evidence for you findings.