Momentum Lab
Wednesday 16 November 2022

Purpose

The purpose of this experiment is to create a collision for which the conservation momentum in two dimensions can be observed. The total momentum of a system will be measured before and after the collision, and these will be compared to determine whether momentum was conserved in the process.

Materials

Two tennis balls, a metre stick, a scale, a phone or other video recorder, Tracker software.

Experiment Procedure

Measure the mass of each tennis ball. Roll two tennis balls towards each other to make them collide. Record a video at 60fps of the collision from above, with the view as straight-on as possible. Make sure there is a full or partial metrestick in the frame of the video for reference.

Analysis Procedure (buttons in *italics*)

1. With Tracker open: *Video → Import* and open the video of the collision.

2. *Track → New → Callibration Tools → Callibration Stick*
   Line the callibration stick up with the metre stick in the video itself, and set the callibration stick length to match the length shown in the video. Optional: *Callibration Stick → Color* and change the colour to make it more visible.

3. Scroll the video slider to the frame in the video where you want to start recording data. This should be sufficiently early before the collision occurs.
   Right click → Set start frame to slider
   Repeat for the end frame in the video, sufficiently long after the collision.

4. Click *Coordinate System* then move the centre of the coordinate axes to the starting position of one of the masses, to set a reference point.

5. *Track → New → Point Mass*
   Shift-click on the centre of the tennis ball to make the first data point. The software will automatically noteand plot the time and position of the ball at this point, then show the next frame. Shift-click the centre of the ball in this frame. Repeat until the ball's location has been recorded over the entire duration of the video.

6. Clicking the vertical axis on the graph generated for the data collected, select a quantity to plot that will be usefull for determining momentum of the tennis ball before and after the collision. It is helpful to have two graphs displayed, one with the x-component of motion, and the second showing the y-component of the motion.

7. Double click a graph to analyze the data plot in a new window. *Analyze →Curve Fitter → line* will plot a line of best fit. Click-and-drag to select the data points to be included in the line of best fit. Parameter values will show at the bottom of the window, and *Analyze → Statistics* will show more information.

8. Repeat the previous steps for the second tennis ball.

Analysis

Was momentum conserved in this collision?
If yes, how do you know? If no, what might explain this?