40 Meter Dash

Introduction
Many professional athletes are judged on how well they can run a certain distance; marathon runners on 26.2 miles, sprinters on how fast they run 100 meters, and football players on how fast they can run the 40. What this experiment will try to achieve is a relationship between the time a runner runs 40m with their velocity and acceleration.

Method
Cones will be set up at the Sports Complex with the spacing given in the Procedure. Each student will run the 40 meters from the start cone to the end cone while being filmed on a digital camera. From this movie, it is possible to get the time it takes to run a distance Δx and construct distance vs. time, velocity vs. time, and acceleration vs. time graphs.

Equipment List
1 laptop, 1 memory stick, 1 Media Card Reader.

Procedure
1. Everyone goes to the Sports Complex with a few people carrying the cones and tape measure and the TA carrying the digital camera.

2. The TA will show the part of the indoor track that will be used. The cones will be set up in a straight line along the central lane of the track. The first pair of cones will mark the starting position (one at each side). The next ten (five per side) cones will be placed 3 meters apart from each other. The ten remaining cones will be setup five meters apart from each other (five per side). There should be a total of 22 cones on the track. Lay down masking tape to connect each pair of cones (should be perpendicular to the track lines).

3. A student will get into the starting position. When the TA says "Go!" the student will run the 40 meters staying as CLOSE to the center of the lane as he can. This will be repeated until every student has run the 40 three times.

4. After each student has run the 40 meters three times, everything will be picked up and taken back to the lab room.

5. Get your Memory Card from the TA and put it in the Memory Card reader. If a window opens asking what to do with the files contained in the Memory Card, click on "Take no action", or "Cancel". Double click on the Quick Time Player icon on the desktop. Click on "File" on the menu bar, then on "Open" from the menu list. Go to "Memory Card (X:)" and then to the directory containing the Video Clips. Open your first Video Clip. Resize the video clip window if necessary.

6. Use the left and right arrows on the keyboard to move *frame-by-frame* throughout the Video Clip. Go to the frame where the runner is crossing through the first cone. This is where *t=0*.

7. Construct a table for each run with the interval number, its length (Δx), and the frames it took to run across that interval. Use the frame per second (fps) rate of the camera to calculate the corresponding time (Δt) it took the runner to go across each interval (fps = 20).

8. Using the average of the two runs with the most similar data; calculate the corresponding speeds for each interval. Also, calculate the corresponding accelerations (You will only be able to calculate 9 acceleration entries). Construct distance vs. time, velocity vs. time, and acceleration vs. time graphs.

Questions

Qualitatively, what differences on the velocity and acceleration graphs would you expect for mid-range runs (1000 m)? Long-range (marathon)?

Comparing your run data with others', discuss what would improve your sprinting.

Is it possible that you had positive velocity and negative acceleration at some point during one or more of your runs? Why?