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9/15/08

Projectile Motion Throw

Purpose: To analyze projectile motion graphically using the program "Logger Pro."

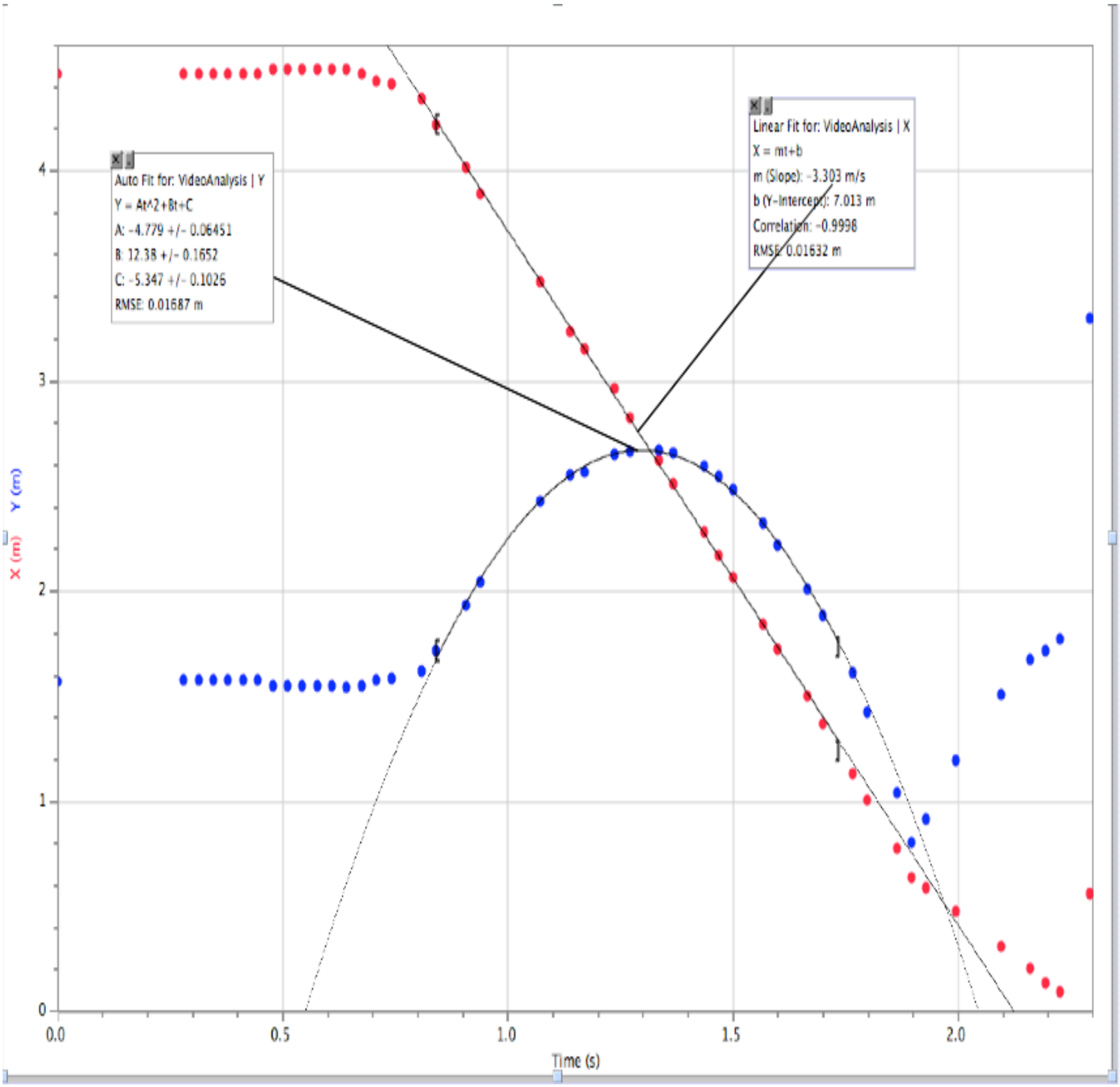
Background: Projectile motion is defined as the path that a launched projectile goes through with the influence of gravity (-9.8m/s^2), and ignoring other factors such as air resistance or propulsion.The soccer ball in this lab will be thrown into the air without the help of any propulsion or wings. Also, air resistance will be ignored when analyzing the graph.

Materials: MacBook with camera, Logger Pro, Soccer ball, Meter stick, Signal cones, Thrower

Procedure: 1.Set up the MacBook on a stable platform and turn on the video capture option in Logger Pro.

2. Place a meter stick on the floor with the signal cones on each end. The cone will serve as an aid in helping to identify the position of the meter stick. Also, the meter stick should be placed preferably in the middle of the screen at a reasonable distance.
3. The thrower will hold the ball close to the end of the screen and signal to press the capture button. Make sure everything goes in the screen.
4. Press the start capture button.
5. Throw the ball into the air and across the screen, but remember to let it bounce once on the ground.
6. Save the video and use Logger Pro to make slope/velocity graphs and analyze.

Data:



Auto Fit for: VideoAnalysis | Y
Y = At^2+Bt+C
A: -4.779 +/- 0.06451
B: 12.38 +/- 0.1652
C: -5.347 +/- 0.1026
RMSE: 0.01687 m
Linear Fit for: VideoAnalysis | X
X = mt+b
m (Slope): -3.303 m/s
b (Y-Intercept): 7.013 m
Correlation: -0.9998
RMSE: 0.01632 m
X (m)
Y (m)
Time (s)
0.0
0.5
1.0
1.5
2.0
0
1
2
3
4

	VideoAnalysis				
	Time (s)	X (m)	Y (m)	Vx (m/s)	Vy (m/s)
1	0	4.466	1.570	0.000	0.029
2	0.2800	4.466	1.579	0.000	0.026
3	0.3133	4.466	1.579	0.000	0.011
4	0.3450	4.466	1.579	0.000	0.003
5	0.3783	4.466	1.579	0.015	-0.022
6	0.4117	4.466	1.579	0.058	-0.087
7	0.4450	4.466	1.579	0.189	-0.283
8	0.4783	4.483	1.553	0.189	-0.284
9	0.5117	4.483	1.553	0.059	-0.088
10	0.5433	4.483	1.553	0.015	-0.029
11	0.5767	4.483	1.553	-0.015	-0.022
12	0.6100	4.483	1.553	-0.088	-0.045
13	0.6417	4.483	1.544	-0.324	0.095
14	0.6750	4.466	1.553	-0.667	0.399
15	0.7083	4.431	1.579	-0.859	0.537
16	0.7417	4.414	1.588	-1.222	0.797
17	0.8083	4.344	1.622	-2.035	1.575
18	0.8400	4.222	1.718	-2.996	2.758
19	0.9067	4.014	1.936	-3.246	3.082
20	0.9400	3.892	2.049	-3.280	2.872
21	1.072	3.475	2.431	-3.263	2.467
22	1.138	3.240	2.553	-3.228	1.717
23	1.170	3.153	2.571	-3.047	1.145
24	1.237	2.962	2.649	-3.241	0.812
25	1.270	2.823	2.666	-3.343	0.303
26	1.335	2.623	2.675	-3.280	-0.147
27	1.368	2.509	2.658	-3.358	-0.701
28	1.435	2.283	2.597	-3.372	-1.143
29	1.468	2.170	2.544	-3.364	-1.712
30	1.500	2.066	2.484	-3.382	-2.231
31	1.567	1.840	2.327	-3.437	-2.678
32	1.598	1.727	2.223	-3.475	-3.124
33	1.665	1.501	2.014	-3.562	-3.491
34	1.698	1.370	1.883	-3.635	-4.069
35	1.765	1.136	1.614	-3.677	-4.773
36	1.797	1.005	1.422	-3.618	-5.425
37	1.863	0.7791	1.040	-3.447	-4.894
38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Observations: It was a sunny day with little wind. The ball was thrown at a reasonable height and the speed was relatively slow. The graph of Vy and Vx starts with a constant velocity(standing) and ends with an upward direction. This is due to the bounce at the end.

Analysis: The Vx part of the graph is a linear slope downwards, with a slope of -3.303m/s. The graph also became flatter towards the end because its speed was reduced after the bounce from the ground. In the graph of Vy, the variable A in the formula y=Ax^2+Bx+C is the acceleration of the ball. The result is pretty close to the ideal acceleration of -4.9(we had -4.779). This is derived from the $S=1/2at^2 + V0t$

which is -9.8/2. The data in Vy alternates between positive and negative because the ball goes up and down, with a bounce at the end. The slight error in the number in the data is due to the outer factor such as wind. Also, the slow frame rate of the camera led to inconsistent image. This might have altered the results.

Conclusions: In this lab, we successfully graphed a projectile motion of a ball moving through the air. From the data gathered, we see that the auto fit analysis indicates -4.779 acceleration, which is very close to the ideal -4.9. By doing the lab, one can gain additional information about projectile motion, in addition to the textbook. The concept of gravity is more tangible after doing the lab physically. For future repetition of this experiment, one may also want to use a camera with a faster frame rate to see a smoother and consistent slope.